

glass spheres is coated with this essence and the cavity filled with a hard white wax.

In the past the best scales for the purpose were obtained from one of the cyprinid fishes of Europe. The supply of pearl essence was curtailed by the outbreak of the Great War, and in 1915 and 1916 numerous inquiries were received by the Bureau concerning the fishes from whose scales the essence could be prepared and details of manufacture of the essence and of artificial pearls. Such information as could be found was supplied, and some experiments were made with the scales of native fishes. Promising samples, although never free from color, were made from the scales of the alewife, or river herring. After treating the scales with ammonia the lustrous particles were separated out by centrifugation. Samples submitted to American representatives of Parisian pearl manufacturers were pronounced off color and lacking in luster. Later one of the Bureau's technologists made some additional experiments, including the digestion of the proteinaceous material, leaving the lustrous particles and a pearly suspension produced, but the results were not wholly satisfactory. At about this time others had succeeded in making pearl essence from the scales of native fishes and the experiments were discontinued for more important investigations. According to report the scales of the alewife, or river herring, sea herring, and shad are employed. The scales are agitated in an ammonia solution and the lustrous particles separated by straining the liquid through several cloths. The material produced is reported to be fully the equal of the imported essence for the manufacture of artificial pearls. The fishermen receive from 15 to 50 cents per pound for the scales, and considerable quantities are now being used for the purpose.

NEW ENGLAND VESSEL FISHERIES.

GENERAL STATISTICS.

In the vessel fisheries centering at Boston and Gloucester, Mass., and Portland, Me., during the past year the number of trips and the catch were not so large as in the previous year, but there was a considerable increase in the total value of the products. There was a large increase in the products landed at Boston during the year, amounting to 14.67 per cent in quantity and 30.19 per cent in value, while at Gloucester there was a decrease of 34.51 per cent in quantity and 31.93 per cent in value, and at Portland a decrease of 40.22 per cent in quantity and 8.60 per cent in value. Statistics of these fisheries have been collected by the local agents and published in monthly bulletins showing by species and fishing grounds the quantities and values of fishery products landed by American and Canadian fishing vessels during the year at these ports. Two annual bulletins have been issued, one showing the catch by months and the other by fishing grounds.

The fishing fleet at these ports during the calendar year 1920 numbered 471 sail, steam, and gasoline screw vessels, including 41 American and 3 Canadian steam trawlers. These vessels landed at Boston 3,342 trips, aggregating 118,558,902 pounds of fish, valued at \$6,136,569; at Gloucester, 2,381 trips, aggregating 46,740,296 pounds, valued at \$1,460,336; and at Portland, 1,883 trips, aggre-

gating 12,981,503 pounds, valued at \$630,108. The total for the three ports amounted to 7,606 trips, aggregating 178,280,701 pounds of fresh and salted fish, having a value to the fishermen of \$8,227,013. This total includes 54 trips, 43 at Boston, 1 at Gloucester, and 10 at Portland, landed by 18 Canadian fishing vessels, amounting to 2,588,218 pounds of fish, valued at \$119,028. Of this quantity, 1,308,774 pounds, valued at \$62,147, were landed at Boston; 271,580 pounds, valued at \$13,606, at Gloucester; and 1,007,864 pounds, valued at \$43,275, at Portland. There was an increase of 9 vessels and 15 trips, but a decrease of 707,929 pounds in the quantity of fish landed, with an increase of \$12,767 in the value, as compared with the previous year. These fish were landed in accordance with an arrangement with the Canadian Government as an emergency war measure granting reciprocal privileges to fishing vessels, by which Canadian fishing vessels were permitted to land their fares at American ports direct from the fishing grounds. Canadian vessels began to utilize this privilege in April, 1918, and the arrangement is still in operation.

Compared with the previous year there was a decrease of 663 trips, or 8.01 per cent, in the total number landed by the fishing fleet at Boston, Gloucester, and Portland, and of 18,200,569 pounds, or 9.26 per cent, in the quantity, with an increase of \$678,630, or 8.99 per cent, in the value of the products landed. The only important species showing an increase in both quantity and value were halibut, mackerel, and swordfish. The catch of halibut increased 1,674,669 pounds, or 79.19 per cent, in quantity, and \$354,630, or 91.59 per cent, in value; the mackerel catch increased 1,580,525 pounds, or 27.66 per cent, in quantity, and \$215,852, or 39.44 per cent, in value; and the catch of swordfish increased 1,648,942 pounds, or 186.80 per cent, in quantity, and \$281,834, or 132.71 per cent, in value. The catch of cod decreased 3,108,838 pounds, or 4.75 per cent, in quantity, but increased \$54,456, or 2.10 per cent, in value; haddock decreased 7,436,708 pounds, or 8.99 per cent, in quantity, and \$53,886, or 1.92 per cent, in value; pollock, 10,191,066 pounds, or 54.34 per cent, in quantity, and \$118,387, or 31.11 per cent, in value; cusk, 208,459 pounds, or 10.10 per cent, in quantity, and \$14,099, or 22.67 per cent, in value; and herring, 3,361,901 pounds, or 32.45 per cent, in quantity, and \$73,487, or 30.64 per cent, in value. The catch of hake increased 381,880 pounds, or 8.80 per cent, in quantity, but decreased \$27,177, or 15.01 per cent, in value. The catch of Newfoundland herring decreased 404,753 pounds, or 11.55 per cent, in quantity, and \$79,626, or 41.95 per cent, in value. There were no tilefish landed at Boston during the year. In the various other species combined there was an increase of 853,897 pounds, or 20.66 per cent, in quantity, and of \$60,368, or 37.85 per cent, in value.

The following tables present in detail, by fishing grounds and by months, the products landed at Boston and Gloucester, Mass., and Portland, Me., by American and Canadian fishing vessels, for the calendar year 1920. The weights of fresh and salted fish given in these statistics represent the fish as landed from the vessels, and the values are those received by the fishermen. The grades, or sizes, given for certain species are those recognized in the trade.

STATEMENT, BY FISHING GROUNDS, OF QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., AND PORTLAND, ME., BY AMERICAN AND CANADIAN FISHING VESSELS, CALENDAR YEAR 1920.

Fishing grounds.	Number of trips.	Cod.					
		Large (10 pounds and over).		Market (under 10 and over 2½ pounds).		Serod (1 to 2½ pounds).	
		Fresh.		Fresh.		Fresh.	
		Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
LANDED AT BOSTON.							
<i>East of 68° W. longitude.</i>							
By American vessels:							
La Have Bank.....	54	767,285	\$51,941	615,401	\$23,382	25,720	\$890
Western Bank.....	85	1,101,050	61,062	456,395	18,094	3,375	80
Quebec Bank.....	9	43,840	1,628	6,340	212		
Green Bank.....	3						
Grand Bank.....	9	38,900	2,123	4,240	136		
St. Peter's Bank.....	4	3,100	186				
Burgoyne Bank.....	2						
Cape North.....	1	16,950	1,526	35,640	952	5,540	110
Cape Shore.....	38	67,100	4,889	54,045	1,968	6,060	96
Roseway Bank.....	1	5,000	260	5,800	174		
By Canadian vessels: La Have Bank.....	3	28,520	1,730	30,500	1,087	1,450	15
<i>West of 68° W. longitude.</i>							
By American vessels:							
Brown Bank.....	104	1,527,829	92,713	1,344,270	45,915	23,850	445
Georges Bank.....	807	10,054,075	618,666	4,775,817	172,394	21,825	361
Cashes Bank.....	3	11,865	932	9,000	201		
Flippin's Bank.....	58	32,940	3,279	21,265	1,133	6,910	138
Middle Bank.....	58	106,257	11,389	74,220	4,583	27,885	417
Jeffrey's ledge.....	59	60,598	4,807	48,885	2,345	13,950	219
South Channel.....	560	2,562,571	166,365	2,241,185	75,734	46,780	765
Nantucket Shoals.....	121	120,365	7,113	259,665	8,532	2,110	39
Off Chatham.....	221	1,328,904	81,414	1,121,769	37,209	66,955	1,067
South.....	9						
Shore, general.....	1,147	775,106	47,740	342,155	14,093	7,540	135
By Canadian vessels:							
Brown Bank.....	25	225,992	12,049	410,062	10,352	7,405	102
Georges Bank.....	15	102,855	6,351	154,355	4,354	1,700	16
Total.....	3,312	19,004,092	1,177,813	12,007,699	422,265	208,715	4,395

LANDED AT GLOUCESTER.

East of 68° W. longitude.

By American vessels:

20	401,440	11,628	36,183	\$2,071	181,565	4,407	2,970	\$154	1,155	11	14,480	\$605
59	4,129,450	124,020	287,063	17,443	2,967,020	73,428	306,126	17,173	51,910	587	76,032	2,786
73	3,710,340	105,672	801,222	44,130	4,091,220	93,400	1,182,225	58,741	14,870	173	3,215	121
5	83,435	2,410	59,805	3,275	12,060	295	6,010	331	2,430	69	3,215	121
23	470,567	14,246	355,095	21,088	56,560	1,447	75,120	4,105	1,065	41	3,215	121
5	265,390	7,962	4,955	297	86,035	2,151	760	42	350	5	8,785	439
12	95,850	2,975	113,065	710	41,060	1,043	1,255	63	370	5	8,785	439
22	19,215	714	113,065	5,653	2,050	83	149,330	7,466	370	5	8,785	439
5												
1												
By Canadian vessels: Quereau Bank												
West of 66° W. longitude.												
By American vessels:												
16	248,975	7,633			319,115	8,194			6,470	93		
180	2,245,224	67,332	46,619	2,569	2,112,540	53,690	78,761	3,888	24,736	209	1,820	53
1	5,000	165			7,660	172						
38	136,170	4,065			456,033	11,382			27,398	363		
49	80,850	2,396	21,300	1,169	37,520	1,005	8,960	467	3,470	51		
4	2,195,290	100,951	595	36	35,050							
1,835												
Total	14,086,065	452,203	1,739,372	98,381	10,409,452	251,643	1,812,117	92,430	133,874	1,692	104,932	4,004

LANDED AT PORTLAND.

East of 66° W. longitude.

By American vessels:

5	17,715	522	1,460	95	7,475	151			270	3		
9	8,965	348			3,780	127	315	20				
3												
2	900	40										
11	26,363	771	4,320	270	3,700	102						
6	615	31										
1												
11	21,825	821			31,140	922			1,710	31		
4												
By Canadian vessels:												
2	56,540	1,930	2,085	156	20,060	502	575	37			370	17
3	50,000	1,000	62,218	3,532			98,046	5,363			24,500	1,348

Quebec Bank.....	300	5				7,700	194			3,235	82	
Grand Bank.....	700	42				12,000	440					
St. Peters Bank.....	8,000	480										
Cape North.....	113,700	4,002				730	22			3,350	133	
Cape Shore.....	1,650	132								300	12	
Roseway Bank.....	46,410	2,174										
By Canadian vessels: La Have Bank.....												
<i>West of 66° W. longitude.</i>												
By American vessels:												
Browns Bank.....	1,055,260	42,680				20,540	1,015			12,230	442	
Georges Bank.....	20,809,185	850,024				19,160	802			30,065	988	
Cashes Bank.....						1,640	98			13,160	446	
Fippenies Bank.....	4,555	312				12,080	763			28,735	1,104	
Middle Bank.....	324,925	20,232				26,915	2,115			158,790	7,014	
Jeffreys Ledge.....	287,403	18,813				43,985	1,964			138,908	6,226	
South Channel.....	31,748,683	1,231,340				450,870	15,606			1,103,845	33,963	
Nantucket Shoals.....	1,177,669	46,269				675	27			3,365	110	
Off Chatham.....	3,159,665	127,203				132,125	5,373			259,716	9,011	
Shore, general.....	380,133	25,555				64,745	2,365			133,740	4,058	
By Canadian vessels:												
Browns Bank.....	44,415	1,451								1,000	20	
Georges Bank.....	55,250	1,601										
Total.....	61,720,438	2,476,056				814,450	31,575			1,934,934	65,575	
LANDED AT GLOUCESTER.												
<i>East of 66° W. longitude.</i>												
By American vessels:												
La Have Bank.....	111,570	1,139				82,465	1,226			2,805	\$72	
Western Bank.....	1,115,205	16,118				119,520	1,794			5,492	94	
Quebec Bank.....	394,120	5,003				16,985	244			7,365	178	
Green Bank.....	240	4				10,470	157			3,680	94	
Grand Bank.....	1,836	27				63,885	958			19,710	567	
St. Peters Bank.....	11,920	178				24,120	487				455	\$9
Cape Shore.....	15,840	198										
The Gully.....						1,565	22			7,960	194	
By American vessels:												
Browns Bank.....	129,540	1,508				19,710	295					
Georges Bank.....	2,505,070	38,681				45,635	680					
Jeffreys Ledge.....	19,500	132				31,900	465					
South Channel.....	2,224,225	26,985				1,377						
Nantucket Shoals.....	45,000	675				47,035	588					
Nantucket Island.....						28,400	426					
Shore, general.....	1,798,465	85,381				306,125	16,138			6,200	117	
Total.....	8,372,231	176,091				750,240	22,909			51,182	1,321	
											455	9

STATEMENT, BY FISHING GROUNDS, OF QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., AND PORTLAND, ME., BY AMERICAN AND CANADIAN FISHING VESSELS, CALENDAR YEAR 1920—Continued.

Fishing grounds.	Haddock.				Hake.			
	Large (over 2½ pounds).		Scrap (1 to 2½ pounds).		Large (6 pounds and over).		Small (under 6 pounds).	
	Fresh.	Salted.	Fresh.	Salted.	Fresh.	Salted.	Fresh.	Salted.
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
LANDED AT PORTLAND.								
East of 69° W. longitude.								
By American vessels:								
La Havre Bank.....	25,125	\$531					1,760	\$31
Western Bank.....							515	17
Grand Bank.....	390	6					470	6
St. Peter's Bank.....					10,160	\$153		
Off Newfoundland.....					255	10	90	4
Capo Shore.....	28,240	1,324			2,000	30		
The Gully.....			4,320	\$65	270	14	3,750	111
By Canadian vessels:							1,000	35
La Havre Bank.....	605	12			2,000	42		
Western Bank.....	451,500	9,090					5,295	79
								1,375
								\$45
West of 69° W. longitude.								
By American vessels:								
Georgia Bank.....	131,640	3,748					30,261	\$20
Cashes Bank.....	555	18			2,765	153		
Platts Bank.....	25,757	2,030	548	11	29,931	1,001	232,315	5,375
Jeddy's Lodge.....	255,865	19,423	12,032	417	12,402	778	198,987	5,841
South Channel.....	391,568	9,831						
Shore, general.....	575,651	36,592	9,337	290	58,839	2,471	469,428	14,873
								282
								10
Total.....	1,800,946	82,638	26,807	773	118,612	4,632	1,940	39
								1,047,896
								27,731
								1,657
Grand total.....	71,983,615	2,794,785	261,419	3,929	1,683,302	59,136	59,122	1,370
								2,962,820
								93,306
								2,112
								64

Fishing grounds.	Pollock.				Cusk.				Halibut.			
	Fresh.		Salted.		Fresh.		Salted.		Fresh.		Salted.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
LANDED AT BOSTON.												
<i>East of 66° W. longitude.</i>												
By American vessels:												
La Have Bank.....	39,695	\$1,394			79,745	\$2,351			83,766	\$19,259		
Western Bank.....	89,240	4,131			6,035	271			213,958	40,500		
Quereau Bank.....	870	20			880	22			218,389	42,551		
Green Bank.....									96,701	19,773		
Grand Bank.....					600	18			271,785	50,431		
St. Peters Bank.....									108,163	19,096		
Burgo Bank.....	28,000	5,600							43,357	8,486		
L'Anse-au-Loup.....	6,800	137			3,430	69			41,979	4,663		
Roseway Bank.....					2,500	50			1,327	463		
By Canadian vessels: La Have Bank.....	555	16										
<i>West of 66° W. longitude.</i>												
By American vessels:												
Browns Bank.....	108,515	4,275			133,105	4,257			115,871	26,617		
Georges Bank.....	692,874	24,375			91,780	2,666			1,101,946	230,320		
Cashes Bank.....	4,240	167			6,408	176			1,185	329		
Flypenques Bank.....	8,365	216			27,780	880			31	10		
Middle Bank.....	80,060	3,154			67,925	1,522			3,193	981		
Jeffreys Ledge.....	76,320	2,621			75,750	2,340			2,519	676		
South Channel.....	622,825	24,139			133,987	2,969			120,507	27,785		
Nantucket Shoals.....	19,127	612			385	15			4,513	1,140		
Off Chatham.....	279,084	9,299			58,850	2,005			36,133	8,760		
Shore, general.....	1,290,529	40,821			38,000	1,104			31,630	3,568		
By Canadian vessels:												
Browns Bank.....	38,060	1,018			14,687	421			2,017	596		
Georges Bank.....	12,885	456			2,800	31			1,290	298		
Total.....	3,337,071	122,421			745,627	21,110			2,500,532	496,615	12,000	1,150
LANDED AT GLOUCESTER.												
<i>East of 66° W. longitude.</i>												
By American vessels:												
La Have Bank.....	12,120	141	780	\$20	166,515	2,709	1,256	\$46	30,843	6,189	70	7
Western Bank.....	147,785	2,002	560	16	174,020	3,389			52,758	9,707	75	9
Quereau Bank.....	89,010	1,195	12,725	366	28,380	601	230		8,291	1,424	4,715	605
Green Bank.....					4,595	89	1,610	58			2,366	389
Grand Bank.....	1,085	14	2,005	60	18,705	386	1,055	37			1,880	177
St. Peters Bank.....					22,565	370	70	2				
Cape Shore.....												
The Gully.....	600	8			520	8	185	6			400	48
By Canadian vessels: Quereau Bank.....			120	3								

STATEMENT, BY FISHING GROUNDS, OF QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., AND PORTLAND, ME., BY AMERICAN AND CANADIAN FISHING VESSELS, CALENDAR YEAR 1920—Continued.

Fishing grounds.	Pollock.			Cusk.			Halibut.		
	Fresh.	Salted.	Value.	Fresh.	Salted.	Value.	Fresh.	Salted.	Value.
LANDED AT GLOUCESTER—continued.									
West of 66° W. longitude.									
By American vessels:	Pounds.		Value.	Pounds.		Value.	Pounds.		Value.
Brown Bank	10,505		\$137						
Georges Bank	111,669		2,023	26,250		\$718	14,483		\$2,112
Jeffrey's Ledge	3,110		70	99,381		1,940	90		14
South Channel	48,555		634	10,530		186			
Nantucket Shoals	9,310		126						
Seal Island	1,710		26	29,915		680	622		132
Shore, general	3,745,246		112,252	9,831		195			
Total	4,183,785	16,780	118,592	598,230	5,353	11,271	107,089	9,795	\$1,235
LANDED AT PORTLAND.									
East of 66° W. longitude.									
By American vessels:									
La Have Bank	1,965		11	3,560		105	69,722		12,402
Western Bank				125		4	137,827		29,256
Quebec Bank							101,485		23,095
Green Bank							68,983		11,683
Grand Bank				600		14	285,651		51,885
St. Peter's Bank							162,339		35,929
Off Newfoundland				2,000		50	11,225		2,070
Cape Sable	340		5	10,330		176	407		100
The Gully							83,504		17,731
By Canadian vessels:									
La Have Bank	760	2,370	77	42,155		633	40,131		6,290
Western Bank	53,975		1,403				576		128
West of 66° W. longitude.									
By American vessels:									
Georges Bank	3,383		88	23,009		630	36,488		7,440
Cashes Bank	30,855		843	121,405		2,858	6,846		1,415
Jeffrey's Ledge	13,467		419	77,380		2,393	1,776		390
South Channel	955		20				1,629		317
Shore, general	913,207	2,885	86	224,625		8,588	134,184		23,292
Total	1,018,067	5,255	163	505,269	290	13,451	1,139,973	228	226,223
Grand total	8,535,860	22,035	643	1,599,126	5,613	47,812	3,767,594	21,765	739,435

Mackerel.

Fishing grounds.

LANDED AT BOSTON.

East of 66° W. longitude.

By American vessels: Cape Shore . . .

West of 66° W. longitude.

By American vessels:

Georges Bank
 Middle Bank
 South Channel
 Nantucket Shoals
 Off Chatham
 South
 Shore, general
 Total

LANDED AT GLOUCESTER.

East of 66° W. longitude.

By American vessels: Cape Shore . . .

West of 66° W. longitude.

By American vessels:

Georges Bank
 Nantucket Shoals
 Shore, general
 Total

LANDED AT PORTLAND.

East of 66° W. longitude.

By American vessels: Cape Shore . . .

West of 66° W. longitude.

By American vessels:

Georges Bank
 Shore, general
 Total
 Grand total

Small (under 1½ pounds).

Medium (1½ to 2½ pounds).

Large (over 2½ pounds).

Fresh.

Salted.

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STATEMENT, BY FISHING GROUNDS, OF QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLoucester, MASS., AND PORTLAND, ME., BY AMERICAN AND CANADIAN FISHING VESSELS, CALENDAR YEAR 1920—Continued.

Fishing grounds.	Miscellaneous.				Total.		Grand total.
	Fresh.		Salted.				
	Pounds.	Value.	Pounds.	Value.			
LANDED AT BOSTON.							
East of 66° W. longitude.							
By American vessels:							
La Have Bank.....	7,919	\$736	2,420,656	\$137,755	2,428,575	\$137,755	
Western Bank.....	10,247	1,158	3,432,480	192,433	3,434,963	192,433	
Quebec Bank.....	328	85	270,907	44,523	270,907	44,523	
Green Bank.....	250	100	96,451	19,873	96,451	19,873	
Grand Bank.....	120	30	323,305	52,922	323,305	52,922	
St. Peters Bank.....			127,198	20,656	127,198	20,656	
Burgo Bank.....			71,357	11,086	71,357	11,086	
Cape North.....			66,050	3,068	66,050	3,068	
Cape Shore.....			1,458,165	130,771	1,458,165	130,771	
Roseway Bank.....	11,815	1,980	13,999	691	13,999	691	
By Canadian vessels: La Have Bank.....			111,262	5,500	111,262	5,500	
West of 66° W. longitude.							
By American vessels:							
Brown Bank.....	103,227	5,029	4,444,717	223,397	4,444,717	223,397	
Georges Bank.....	2,419,339	431,268	40,112,646	2,342,129	40,112,646	2,342,129	
Cashes Bank.....			46,488	2,349	46,488	2,349	
Flippenles Bank.....	200	8	7,563	7,563	7,563	7,563	
Middle Bank.....	39,883	2,769	112,804	55,655	112,804	55,655	
Jeffrey's Ledge.....	14,902	810	924,753	924,753	924,753	40,913	
South Channel.....	881,360	47,880	764,350	40,913	764,350	40,913	
Nantucket Shoals.....	67,632	5,098	43,043,073	1,635,478	43,043,073	1,635,478	
Off Chatham.....	285,264	15,634	238,269	29,200	2,520	2,520	
South.....			3,467,976	349,702	3,467,976	349,702	
Shore, general.....	3,015,503	128,114	6,929,627	9,000	6,929,627	32,852	
By Canadian vessels:							
Brown Bank.....	31,814	3,305	8,450,846	13,700	8,464,546	509,143	
Georges Bank.....	90,083	14,253	776,292	29,284	776,292	29,284	
Total.....	6,927,851	655,327	118,301,892	6,114,463	118,558,902	6,136,509	

LANDED AT GLOUCESTER.

East of 69° W. longitude.

By American vessels:

La Have Bank.....	987,073	27,460	44,064	2,370	1,031,737	29,830
Western Bank.....	8,793,885	231,419	612,296	35,340	9,396,261	296,759
Quebec Bank.....	8,332,335	207,714	2,103,651	107,371	10,445,693	315,085
Green Bank.....	111,450	2,956	74,331	4,152	1,185,791	37,108
Grand Bank.....	613,088	17,117	468,885	26,461	1,083,933	45,408
St. Peters Bank.....	411,115	11,189	3,785	81	416,900	11,537
Off Newfoundland.....	110,157	.....	3,067,024	110,157	3,067,024	110,157
Cape Shore.....	170,200	5,019	461,987	39,428	631,887	44,417
The Gully.....	25,360	827	21,750	.....	45,100	1,803
By Canadian vessels: Quebec Bank.....	.....	.....	271,380	13,606	271,380	13,606

West of 69° W. longitude.

By American vessels:

Brown's Bank.....	770,525	18,578	127,775	6,506	770,525	18,578
Georges Bank.....	7,172,598	167,502	.....	.....	7,340,283	174,068
Jeffreys Ledge.....	36,410	575	.....	.....	36,410	575
Ipwich Bay.....	26,000	466	.....	.....	26,000	466
South Channel.....	3,044,901	45,471	.....	.....	3,044,901	45,471
Nantucket Shoals.....	172,381	6,830	300,072	31,180	472,453	38,010
Seal Island.....	175,695	4,527	37,735	1,835	213,430	6,362
Shore, general.....	8,258,877	332,837	595	36	8,259,472	332,873
Total.....	3,9112,933	1,080,577	7,027,343	379,759	46,740,296	1,490,336

LANDED AT PORTLAND.

East of 69° W. longitude.

By American vessels:

La Have Bank.....	300	75	.....	.....	116,022	13,834
Western Bank.....	.....	.....	.....	.....	172,997	29,867
Quebec Bank.....	310	78	.....	.....	104,795	23,173
Green Bank.....	.....	.....	.....	.....	69,463	11,739
Grand Bank.....	.....	.....	.....	.....	334,356	53,251
St. Peters Bank.....	451	75	.....	.....	103,750	34,049
Off Newfoundland.....	.....	.....	.....	.....	15,225	2,150
Cape Shore.....	40,584	8,860	.....	.....	218,571	18,996
The Gully.....	.....	.....	.....	.....	84,504	17,765
By Canadian vessels:	.....	.....	.....	.....	.....	.....
La Have Bank.....	.....	.....	.....	.....	174,321	9,739
Western Bank.....	.....	.....	.....	.....	759,958	22,381

1 Herring. Other items under "Miscellaneous" include bluebacks, 31,650 pounds, value \$530; butterfish, 13,087 pounds, value \$2,561; flounders, 3,637,774 pounds, value \$166,895; herring, 3,900,960 pounds, value \$56,144; rosefish, 67,613 pounds, value \$2,030; shad, 115,792 pounds, value \$6,322; sharks, 15,262 pounds, value \$405; skates, 4,425 pounds, value \$98; smelt, 10,940 pounds, value \$1,216; sturgeon, 3,301 pounds, value \$630; swordfish, 2,531,669 pounds, value \$494,292; tuna, 12,001 pounds, value \$94; whiting, 800 pounds, value \$4; wolfish, 170,729 pounds, value \$4,926; squid, 1,980 pounds, value \$36; lobster, 100 pounds, value \$33; livers, 772,329 pounds, value \$24,715; sounds, 6,383 pounds, value, \$230; and: spawn, 121,776 pounds, value \$8,167.

STATEMENT, BY FISHING GROUNDS, OF QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., AND PORTLAND, ME., BY AMERICAN AND CANADIAN FISHING VESSELS, CALENDAR YEAR 1920—Continued.

Fishing grounds.	Miscellaneous.				Total.				Grand total.	
	Fresh.		Salted.		Fresh.		Salted.			
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.		
LANDED AT PORTLAND—continued.										
West of 69° W. longitude.										
By American vessels:										
Browns Bank.....	10,466	\$2,198	10,466	\$2,198	10,466	\$2,198	10,466	\$2,198		
Georges Bank.....	122,235	22,273	340,770	38,883	340,770	38,883	340,770	38,883		
Cashes Bank.....	10,350	8	138,587	5,966	138,587	5,966	138,587	5,966		
Platts Bank.....	202	202	633,218	22,476	633,218	22,476	633,218	22,476		
Jeffreys Ledge.....	21,137	894	678,268	35,344	678,268	35,344	678,268	35,344		
South Channel.....	265	13	396,947	9,930	396,947	9,930	396,947	9,930		
Shore, general.....	4,081,784	62,415	8,484,138	296,573	8,484,138	296,573	8,495,670	297,211		
By Canadian vessels: Georges Bank.....	73,585	11,155	73,585	11,155	73,585	11,532	73,585	11,155		
Total.....	4,362,190	108,186	12,752,254	617,772	12,752,254	617,772	12,981,503	630,108		
Grand total.....	11,418,571	770,178	3,097,024	110,137	170,167,009	7,812,817	178,280,701	8,227,013		

STATEMENT, BY MONTHS, OF QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., AND PORTLAND, ME., BY AMERICAN AND CANADIAN FISHING VESSELS, 1920.¹

Month.	Number of trips.	Cod.					
		Large (10 pounds and over).		Market (under 10 and over 2½ pounds).		Scrod (1 to 2½ pounds).	
		Fresh.	Salted.	Fresh.	Salted.	Fresh.	Salted.
		Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
LANDED AT BOSTON.							
January.....	269	947,700	\$88,987	716,380	\$37,070	40,355	\$901
February.....	195	2,075,600	164,768	647,332	29,240	6,895	170
March.....	315	3,333,703	182,451	906,045	36,193	5,485	127
April.....	214	1,333,829	69,357	617,078	21,289	16,090	267
May.....	254	1,565,234	71,246	1,030,387	33,451	24,885	368
June.....	271	1,570,880	89,377	1,290,085	41,024	8,700	126

July.....	314	1,304,398	79,121	1,371,48	39,663	4,029	63
August.....	355	1,746,450	90,245	1,836,695	40,710	4,180	45
September.....	344	1,648,865	92,425	1,741,290	38,364	19,180	264
October.....	289	1,582,428	92,470	1,674,900	33,569	11,605	123
November.....	229	1,147,438	94,260	1,241,698	20,537	51,530	702
December.....	253	1,769,167	62,946	1,832,113	32,155	74,530	1,239
Total.....	3,342	19,041,062	1,177,813	20,218,875	423,265	298,715	4,395
LANDED AT GLOUCESTER.							
January.....	194	206,935	13,722	220,657	492	3,205	46
February.....	112	154,300	10,712	165,012	259	85	2
March.....	332	1,083,210	41,214	1,124,424	3,445	845	8
April.....	452	2,375,320	80,192	2,455,512	17,124	5,180	58
May.....	296	2,780,765	89,650	2,870,415	46,702	19,130	286
June.....	99	2,204,832	69,458	2,274,290	3,325	51,808	812
July.....	90	2,218,950	66,066	2,285,016	308,206	17,280	610
August.....	73	1,583,575	41,318	1,624,893	137,770	4,305	164
September.....	83	514,483	16,512	530,995	133,885	20,241	32
October.....	211	494,915	15,262	510,177	446,501	17,282	509
November.....	221	188,285	14,259	202,544	290,919	7,705	133
December.....	228	223,495	9,652	233,147	570,575	48,970	1,875
Total.....	2,381	14,086,065	452,203	15,538,268	2,649	3,715	814
LANDED AT PORTLAND.							
January.....	60	48,271	4,364	52,635	2,997	18,132	439
February.....	59	64,735	5,059	69,794	1,032	4,899	170
March.....	172	104,225	6,253	110,478	2,530	7,066	192
April.....	234	263,170	10,287	273,457	315	7,484	111
May.....	234	163,011	8,550	171,561	3,685	5,378	73
June.....	377	225,766	12,246	238,012	1,587	3,829	54
July.....	154	262,688	15,011	277,699	45	1,068	23
August.....	133	254,424	11,396	265,820	330	3,877	370
September.....	113	198,384	5,808	204,192	575	12,701	445
October.....	130	128,667	6,209	134,876	98,996	5,449	23,055
November.....	110	64,811	5,323	70,134	1,195	11,166	116
December.....	77	58,498	5,123	63,621	50	19,178	40
Total.....	1,883	1,756,850	95,859	1,852,709	2,551	59,681	611
Grand total.....	7,905	34,847,007	1,725,875	35,572,882	22,072	155,689	2,478
Grounds east of 66° W. long.							
Grounds west of 66° W. long.	520	11,427,557	400,091	12,827,648	224,018	115,885	1,581
Landed at Boston in 1919.....	7,083	23,419,450	1,325,784	24,745,234	472,962	442,302	5,316
Landed at Gloucester in 1919.....	2,754	29,131,589	1,030,220	30,161,809	321,434	437	2,415
Landed at Gloucester in 1919.....	2,955	18,308,512	567,307	18,875,819	228,526	383,344	7,783
Landed at Portland in 1919.....	2,550	2,826,747	131,262	3,057,909	31,644	137,801	2,202
Landed at Portland in 1919.....						96,416	4,077

1 The above statistics for the year 1920 include 54 trips landed by Canadian fishing vessels, 43 at Boston, 1 at Gloucester, and 10 at Portland, amounting to 2,588,218 pounds of fish, value \$119,028.

STATEMENT. BY MONTHS, OF QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., AND
PORTLAND, ME., BY AMERICAN AND CANADIAN FISHING VESSELS. 1920—(Continued.)

Month	Haddock.				Hake.			
	Large (over 2½ pounds).		Scrod (1 to 2½ pounds).		Large (3 pounds and over).		Small (under 6 pounds).	
	Fresh.	Salted.	Fresh.	Salted.	Fresh.	Salted.	Fresh.	Salted.
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
LANDED AT BOSTON.								
January.....	5,926,213	\$39,008	4,800	\$175	13,163	\$898	31,241	\$2,770
February.....	6,214,746	364,801			17,759	1,254	9,415	\$28
March.....	8,910,530	302,031			17,940	1,145	17,200	1,093
April.....	4,531,555	105,720			13,190	738	16,680	663
May.....	5,069,180	181,700			24,705	1,556	65,195	2,353
June.....	4,112,980	150,987			33,070	1,629	79,030	2,803
July.....	3,677,270	120,113			30,880	1,114	220,215	7,982
August.....	4,658,175	121,033			69,845	3,046	206,513	7,911
September.....	5,780,368	144,946			59,370	2,661	209,255	11,125
October.....	6,067,915	154,011			279,074	7,361	302,385	13,125
November.....	4,750,689	246,401			200,690	7,784	401,024	13,267
December.....	4,614,717	248,375			34,484	2,650	233,676	10,437
Total.....	64,720,438	2,476,066	31,150	772	814,450	31,575	1,994,964	65,575
LANDED AT GLOUCESTER.								
January.....	89,275	4,318			24,290	1,344		
February.....	235,675	14,059			10,965	1,026		
March.....	1,331,725	38,737			15,785	1,159		
April.....	1,470,680	40,157			17,820	1,009		
May.....	944,050	19,249			48,860	785		
June.....	1,159,150	16,873			27,940	1,420		
July.....	345,631	4,957			76,775	2,776		
August.....	839,590	9,150			138,800	4,431		
September.....	1,381,910	13,801			89,475	1,969		
October.....	491,065	4,844			10,255	233		
November.....	26,895	4,747			22,135	611		
December.....	62,555	3,221			8,160	290		
Total.....	8,372,231	176,091	196,162	2,384	759,240	22,949	51,182	1,321
							455	9

LANDED AT PORTLAND.

LANDED AT PORTLAND.									
January.....	102,880	8,385	2,967	111	2,109	104	.....	12,466	716
February.....	137,635	11,407	260	260	2,273	238	.....	24,427	1,785
March.....	135,860	11,536	6,165	184	7,748	615	.....	75,713	3,960
April.....	268,253	13,091	5,515	46	14,060	728	.....	147,300	4,637
May.....	181,099	6,068	6,474	46	20,781	553	49	167,171	3,673
June.....	15,234	1,167	1,456	10	8,419	245	1,940	63,458	1,365
July.....	4,046	281	96	6	19,995	496	.....	67,888	1,255
August.....	852,479	19,119	265	7	6,582	173	.....	36,179	624
September.....	6,611	6,390	485	11	2,211	79	.....	16,242	458
October.....	19,710	849	785	3.5	23,779	484	.....	137,109	2,669
November.....	5,331	4,051	1,385	3.5	8,366	471	.....	188,161	3,589
December.....	86,968	6,274	1,343	8	5,267	408	.....	91,242	3,034
Total.....	1,860,946	82,638	26,807	773	118,612	4,652	1,940	1,047,896	27,731
Grand total.....	74,983,615	2,734,785	231,419	3,929	1,683,302	69,136	1,370	2,982,820	93,306
Grounds east of 66° W. long.....	4,024,846	143,552	33,507	433	385,520	6,534	49,922	64,200	2,346
Grounds west of 66° W. long.....	70,358,769	2,591,233	217,912	3,496	1,317,782	52,602	6,200	2,918,560	90,960
Landed at Boston in 1919.....	55,536,930	2,128,151	231,254	29	808,379	39,736	.....	1,497,928	64,720
Landed at Gloucester in 1919.....	17,150,377	326,149	588,421	6,718	746,097	24,130	39,070	1,500,500	500
Landed at Portland in 1919.....	6,954,764	145,183	69,257	1,611	188,887	11,334	.....	1,058,165	39,271

Month.

Pollock.

Cusk.

Abstract.

Month.	Pollock.				Cusk.				Halibut.			
	Fresh.		Salted.		Fresh.		Salted.		Fresh.		Salted.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
LANDED AT BOSTON.												
January.....	53,695	\$3,634			97,800	\$4,481			30,859	\$9,908		
February.....	19,890	1,092			27,300	1,543			83,713	19,634		
March.....	34,298	2,459			24,435	1,081			121,167	24,550		
April.....	64,475	4,488			56,540	1,901			272,726	62,352		
May.....	154,533	6,602			34,690	901			592,831	84,970		
June.....	232,805	7,722			44,133	1,376			388,055	65,490		
July.....	250,974	10,446			29,855	774			274,798	49,847		\$1,150
August.....	479,310	24,561			32,660	860			290,190	62,302		
September.....	514,250	16,024			25,275	623			241,128	52,403		
October.....	640,112	15,193			51,161	1,077			189,399	41,415		
November.....	511,479	15,919			130,875	2,588			111,962	25,349		
December.....	381,285	13,585			184,780	3,756			24,031	8,375		
Total.....	3,337,074	122,421			745,627	21,110			2,540,532	496,615		1,150

STATEMENT, BY MONTHS, OF QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., AND PORTLAND, ME., BY AMERICAN AND CANADIAN FISHING VESSELS, 1920—Continued.

Month	Pollock.				Cusk.				Haddock.			
	Fresh.		Salted.		Fresh.		Salted.		Fresh.		Salted.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
LANDED AT GLOUCESTER.												
January.....	374,154	\$23,327	4,905	\$123	4,905	\$123	.....	.....	.....	.....	.....	.....
February.....	37,780	3,949	1,805	23	1,805	23	.....	.....	.....	.....	.....	.....
March.....	46,090	3,401	1,525	35	1,525	35	.....	.....	.....	.....	.....	.....
April.....	66,065	3,971	10,100	295	10,100	295	.....	.....	.....	.....	.....	.....
May.....	78,030	1,754	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
June.....	107,490	1,465	200	147	58,300	1,147	.....	.....	.....	.....	.....	.....
July.....	52,875	717	110	85	10,305	222	.....	.....	.....	.....	.....	.....
August.....	29,520	430	2,885	71	196,700	3,454	1,891	98	23,178	4,741	75	\$9
September.....	140,140	2,280	8,735	291	154,781	3,104	315	.....	20,075	2,895	65	264
October.....	1,191,897	14,927	1,780	93	64,410	1,216	962	74	8,401	1,448	.....	.....
November.....	1,004,959	23,739	3,220	93	95,659	1,222	2,090	71	.....	.....	.....	.....
December.....	1,055,775	38,922	2,220	6	12,410	220	185	6	30,843	6,189	575	69
Total.....	4,182,755	118,592	16,780	480	598,230	11,271	5,353	230	107,080	19,598	9,736	1,235
LANDED AT PORTLAND.												
January.....	3,077	161	.....	.....	19,566	1,333	.....	.....	33,149	7,194	.....	.....
February.....	3,121	220	.....	.....	12,937	998	.....	.....	51,998	10,710	.....	.....
March.....	8,667	520	.....	.....	57,200	2,685	.....	.....	15,990	84,218	.....	.....
April.....	22,159	1,123	.....	.....	91,291	2,834	.....	.....	105,674	24,256	.....	.....
May.....	87,502	2,879	.....	.....	71,601	1,579	.....	.....	185,269	25,269	.....	.....
June.....	429,098	5,639	.....	.....	13,232	438	.....	.....	117,021	18,397	.....	.....
July.....	31,629	699	.....	.....	39,571	1,046	.....	.....	136,547	25,092	.....	.....
August.....	38,034	775	2,370	77	28,597	645	.....	.....	91,639	18,788	.....	.....
September.....	166,525	4,119	83	3	8,383	369	360	8	101,163	21,506	.....	.....
October.....	126,955	2,609	115	3	51,243	1,132	.....	.....	122,139	23,654	.....	.....
November.....	68,449	1,805	.....	.....	75,277	1,660	.....	.....	153,455	32,290	.....	.....
December.....	35,819	970	.....	.....	45,012	1,255	.....	.....	131,021	24,024	.....	.....
Total.....	1,018,007	20,472	5,255	163	505,269	15,451	260	8	1,150,973	224,223	.....	.....
Grand total.....	8,508,896	261,485	22,035	643	1,849,136	47,852	5,613	238	3,797,594	739,446	21,736	2,385
Grounds east of 66° W. long.....												
Grounds west of 66° W. long.....	471,940	16,000	18,200	542	598,280	11,325	4,426	157	2,147,616	411,305	14,786	1,085
Landed at Boston in 1919.....	8,000,916	245,365	3,475	101	1,280,870	36,507	1,187	81	1,619,973	328,071	7,000	700
Landed at Gloucester in 1919.....	3,000,781	105,036	.....	.....	7,786,654	22,980	.....	.....	1,329,384	260,112	2,000	320
Landed at Portland in 1919.....	14,598,788	248,205	55,101	1,400	638,067	13,373	37,962	1,638	357,490	54,820	12,600	1,770
Landed at Portland in 1919.....	1,066,784	25,889	55,515	15	679,625	24,152	.....	.....	413,217	80,169	.....	.....

Mackerel.

Month.	Large (over 2½ pounds).				Medium (1½ to 2½ pounds).				Small (under 1½ pounds).			
	Fresh.		Salted.		Fresh.		Salted.		Fresh.		Salted.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
LANDED AT BOSTON.												
May.....	1,311,693	\$119,557	9,000	\$850	310,359	\$23,247	21,000	\$1,879	24,180	\$1,283		
June.....	2,323,650	203,205	197,700	16,954	625,899	46,110	1,800	189	61,130	10,410		
July.....	514,385	50,756	15,000	1,328	119,827	21,626			63,857	12,028		
August.....	32,244	7,173			56,660	11,747			179,601	34,852		
September.....	42,225	11,211							5,960	1,529		
October.....	36,465	6,915			108,200	19,169						
November.....	178,290	30,920			3,700	1,046						
December.....	6,180	1,726										
Total.....	4,444,495	431,406	222,300	18,892	1,224,687	147,979	22,800	2,059	359,738	69,102		
LANDED AT GLOUCESTER.												
June.....	16,550	790	461,687	39,428	45,200	2,293	65,800	6,952				
July.....	10,801	1,080	230,684	23,779	1,400	280		88			1,200	\$102
August.....			1,800	218	8,485	1,448	388	41				
September.....												
October.....	13,691	2,908	333	50								
November.....	54,698	8,700										
Total.....	95,140	13,538	693,604	63,475	55,145	3,991	66,988	7,081			1,200	102
LANDED AT PORTLAND.												
June.....	82,259	7,249	2,000	175	3,515	400						
July.....	12,146	2,045			1,466	183						
August.....	1,707	419			1,417	116			410	6		
September.....	3,542	940							125	8		
October.....									550	55		
November.....	815	196			17,332	2,620						
Total.....	100,489	10,869	2,000	175	23,750	3,319			1,082	69		
Grand total.....	4,640,124	455,855	918,204	82,542	1,303,582	155,287	89,788	9,140	340,821	69,171	1,200	102
Grounds east of 66° W. long.....												
Grounds west of 66° W. long.....	1,239,328	120,714	643,887	55,007	1,303,582	155,287	20,000	1,800	340,823	69,171	1,200	102
Landed at Boston in 1919.....	3,400,796	335,139	274,317	27,455	1,179,125	13,899	69,788	7,340	1,063,778	108,019	3,200	442
Landed at Gloucester in 1919.....	2,621,081	237,742	166,000	13,556	179,125	13,899	6,400	960	21,898	838	34,288	2,538
Landed at Portland in 1919.....	221,129	34,211	1,181,959	102,223	1,035	98			5,874	953	20	2
Landed at Portland in 1919.....	188,050	29,881	4,559	427	12,800	1,461						

July.....	133,495	23,430	.....	752,482	70,961	1,957	132	751,130	70,793
August.....	182,102	15,125	.....	1,469,423	67,896	6,775	332	1,476,198	67,228
September.....	314,132	11,855	.....	778,988	47,300	210,097	11,246	989,085	58,546
October.....	279,828	2,092	.....	920,878	39,369	.....	7	921,083	39,576
November.....	15,465	687	.....	705,601	51,205	.....	.....	705,604	51,205
December.....	6,161	132	.....	448,261	21,370	.....	.....	448,261	21,370
Total.....	4,362,180	108,186	.....	12,752,351	617,772	229,249	12,336	12,981,503	630,108
Grand total.....	11,418,571	770,178	.....	170,167,069	7,812,817	8,113,692	414,196	178,280,701	8,227,013
Grounds east of 66° W. long.....	73,377	13,177	.....	29,813,631	1,351,226	7,384,083	390,601	37,427,711	1,720,830
Grounds west of 66° W. long.....	11,346,194	757,001	.....	140,323,378	6,461,591	7,529,609	41,592	140,852,987	6,506,183
Landed at Boston in 1919.....	4,565,511	390,048	.....	103,208,770	4,698,747	182,600	14,603	103,391,370	4,713,350
Landed at Gloucester in 1919.....	113,809	9,415	.....	61,621,587	1,587,000	9,749,370	538,592	71,370,957	2,145,962
Landed at Portland in 1919.....	7,215,670	113,863	.....	21,713,191	688,976	5,752	165	21,718,943	689,441

* Includes herring from Newfoundland, 3,097,024 pounds salted, value \$110,157.

The fishery products landed at Boston and Gloucester, Mass., and Portland, Me., by fishing vessels each year are taken principally from fishing grounds lying off the coast of the United States. In the calendar year 1920, 78.88 per cent of the quantity and 79 per cent of the value of the catch landed by American and Canadian fishing vessels were taken from these grounds; 3.35 per cent of the quantity and 4.63 per cent of the value, consisting largely of herring, from fishing banks off the coast of Newfoundland, and 17.75 per cent of the quantity and 16.36 per cent of the value from fishing grounds off the Canadian Provinces. Newfoundland herring constituted 1.73 per cent of the quantity and 1.33 per cent of the value of the fishery products landed at these ports during the year. The herring were taken from the treaty coast of Newfoundland, and the cod, haddock, hake, halibut, and other species from that region were obtained from fishing banks on the high seas. All fish caught by American fishing vessels off the coast of the Canadian Provinces were from offshore fishing grounds. The catch from each of these regions is given in detail in the following table:

QUANTITY AND VALUE OF FISH LANDED BY AMERICAN AND CANADIAN FISHING VESSELS AT BOSTON AND GLOUCESTER, MASS., AND PORTLAND, ME., IN 1920, FROM FISHING GROUNDS OFF THE COAST OF THE UNITED STATES, NEWFOUNDLAND, AND CANADIAN PROVINCES.

Species.	United States.		Newfoundland.		Canadian Provinces.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Cod:								
Fresh.....	38,032,530	\$1,802,329	1,056,142	\$32,010	19,318,495	\$597,081	58,407,167	\$2,431,420
Salted.....	135,900	7,020	510,480	29,529	3,212,035	169,668	3,858,415	206,217
Haddock:								
Fresh.....	70,576,671	2,594,729	15,086	257	4,643,277	143,728	75,235,034	2,738,714
Salted.....			9,750	297	34,693	1,041	44,443	1,338
Hake:								
Fresh.....	4,207,942	143,136	134,415	2,521	323,765	6,785	4,666,122	152,442
Salted.....	282	10	25,785	724	29,167	700	55,234	1,434
Pollock:								
Fresh.....	8,065,206	245,375	29,135	5,615	444,525	10,495	8,538,866	261,485
Salted.....	2,885	86	2,005	60	17,145	497	22,035	643
Cusk:								
Fresh.....	1,253,961	35,827	49,065	927	546,100	11,078	1,849,126	47,832
Salted.....	502	14	2,765	97	2,346	127	5,613	238
Halibut:								
Fresh.....	1,619,978	328,071	1,048,314	198,164	1,099,302	213,201	3,767,594	739,436
Salted.....	7,000	700	4,476	566	10,260	1,119	21,736	2,385
Mackerel:								
Fresh.....	5,045,201	550,596			1,239,328	120,714	6,284,529	671,310
Salted.....	345,305	34,927			663,887	56,857	1,009,192	91,784
Herring:								
Fresh.....	3,900,960	56,144					3,900,960	56,144
Salted.....			3,097,024	110,157			3,097,024	110,157
Swordfish: Fresh...	2,471,837	481,399	751	203	59,081	12,600	2,531,669	494,202
Miscellaneous: Fresh...	4,973,397	219,458	70	2	12,475	372	4,985,942	219,832
Total.....	140,639,557	6,499,821	5,985,263	381,129	31,655,881	1,346,063	178,230,701	8,227,013

SPECIES.

COD.

In 1920 the fishing fleet landing fish at Boston, Gloucester, and Portland was not quite so large as in the previous year. There were 20 vessels in the salt-bank fishery, or 11 more than in the previous year, and 111 in the market fishery, the same number as in the previous year. These vessels landed their fares of cod and other

ground fish at these ports during the year, and large quantities of cod were also landed by vessels fishing on the shore grounds. The total catch of cod landed at these ports during the year was 62,265,-582 pounds, valued at \$2,637,637, of which 58,407,167 pounds, valued at \$2,431,420, were fresh, and 3,858,415 pounds, valued at \$206,217, were salted. Cod ranked second among the various species landed.

HADDOCK.

The catch of haddock for the year ranked first in both quantity and value, exceeding that of cod by 13,013,895 pounds and \$102,415. The quantity of haddock landed at these ports by fishing vessels during the year amounted to 75,279,477 pounds, valued at \$2,740,052, all of which was fresh except 44,445 pounds, valued at \$1,338. These fish were taken chiefly on Georges Bank and in South Channel, and the greater part of the catch, or 64,751,888 pounds, valued at \$2,746,828, was landed at Boston.

HAKE.

The catch of hake amounted to 4,721,356 pounds, valued at \$153,876, all landed fresh except 55,234 pounds, valued at \$1,434, salted. There was an increase of 381,880 pounds, or 8.80 per cent, in the quantity, but a decrease of \$27,177, or 15.01 per cent, in the value as compared with the previous year. The yield of this species has been comparatively small in recent years.

POLLOCK.

The catch of pollock amounted to 8,560,901 pounds, valued at \$262,128, all landed fresh except 22,035 pounds, valued at \$643, salted. This was the smallest catch of pollock in many years. There was a falling off in the catch of this species of over 10,000,000 pounds as compared with the previous year.

CUSK.

The catch of cusk amounted to 1,854,739 pounds, valued at \$48,070, all of which was fresh, except 5,613 pounds, valued at \$238, salted. The yield was 200,000 pounds less than in the previous year. The catch of this species has declined considerably in recent years.

HALIBUT.

The quantity of halibut landed was 3,789,330 pounds, valued at \$741,821, all of which was fresh except 21,736 pounds salted, valued at \$2,385. There was an increase of 1,674,669 pounds in quantity and \$354,630 in value as compared with the previous year. The catch was the largest taken in any year in the past five years. The next largest catch in this period was in 1916, when 3,458,765 pounds were landed at these ports. There has been a large increase in the receipts of halibut at Portland, which amounted in 1920 to 1,159,973 pounds, the next largest in the past five years being 535,314 pounds in 1916. There has also been a large increase in the receipts of halibut at Boston in recent years, but a decrease in those at Gloucester.

MACKEREL.

The total catch of fresh mackerel taken by the American fishing fleet in 1920 was 79,799 barrels, compared with 53,992 barrels in 1919, an increase of 25,807 barrels. The total catch of salted mackerel was 4,897 barrels, compared with 7,007 barrels the previous year, a decrease of 2,110 barrels. The quantity of mackerel landed at Boston, Gloucester, and Portland by the fishing fleet during the year was 7,293,721 pounds, valued at \$763,094, of which 6,284,529 pounds, valued at \$671,310, were fresh, and 1,009,192 pounds, valued at \$91,784, were salted. These were all landed by American fishing vessels. There was an increase in the total catch of mackerel landed at these ports of 1,580,525 pounds in quantity and \$215,852 in value over the previous year.

The season of 1920 was one of the best on record in the southern mackerel fishery for both the purse-seine and gill-net vessels. The fleet numbered about 50 seiners and 125 netters. The first fare, consisting of 3,600 pounds of large mackerel, was landed by a Gloucester vessel, April 14, at Cape May. Some of the best stocks made by the seiners in the southern fishery were from \$9,153 to \$26,449, the crews sharing from \$197 to \$649. The mackerel caught weighed from 1½ to 3½ pounds each, averaging about 2 pounds each, and sold from 8 to 22 cents per pound, according to market conditions. The schooner *Helen G. McLean*, from Nova Scotia, engaged in the southern mackerel fishery, and is said to be the only Canadian vessel to engage in this fishery for 25 years. The first arrival at Boston was a fare of 35,000 pounds of large and medium fresh mackerel on May 14, caught 35 miles south by west of Block Island, and sold at 18 cents per pound. In May there was a large body of mackerel off South Shoal Lightship, and the receipts at Boston landed by vessels were larger than for the same month in any recent year. The catch of mackerel on the Cape Shore was disappointing; the weather was foggy and the fish were well offshore, wild, and hard to catch. The first fares landed at Boston from this locality arrived on June 7. The fresh mackerel sold at 12 cents per pound and the salted mackerel at \$17 to \$17.50 per barrel. Later arrivals of fresh mackerel sold from 10 to 10½ cents per pound. The Cape Shore fleet consisted of 30 vessels, which landed 1,290,000 pounds of fresh mackerel and 3,217 barrels of salt mackerel, compared with 32 vessels, and 2,119,000 pounds of fresh and 6,275 barrels of salt mackerel the previous year. The total catch of mackerel up to July 1 was 60,842 barrels fresh and 3,357 barrels salted, compared with 38,787 barrels fresh and 6,452 barrels salted the previous year.

SWORDFISH.

The catch of swordfish amounted to 2,531,669 pounds, valued at \$494,202. The number of vessels engaged in this fishery was 62, or 6 more than in the previous year, and there was a large increase in the catch.

FLOUNDERS.

The catch of flounders in the vessel fisheries amounted to 3,637,774 pounds, valued at \$166,895, an increase of 1,185,918 pounds, or 48.36 per cent, in quantity, and \$63,845, or 61.95 per cent, in value.

The catch taken by boats under 5 tons net tonnage is not included in these statistics.

HERRING.

The catch of herring amounted to 6,997,984 pounds, valued at \$166,301. Of this quantity, 3,900,960 pounds, valued at \$56,144, were taken off the coast of the United States and landed fresh, and 3,097,024 pounds, valued at \$110,157, were salted Newfoundland herring.

VESSEL FISHERIES AT SEATTLE, WASH.

In the vessel fisheries at Seattle, Wash., there has been some increase in the total quantity and value of products landed by the fishing fleet, but considerable falling off in the products landed by collecting vessels as compared with the previous year. The increase in products landed by the fishing fleet was due to a larger catch of halibut, there being a marked decrease in the catch of sablefish, "lingcod," and rockfishes. Statistics of the vessel fisheries at Seattle have been collected by the local agent and published as monthly and annual statistical bulletins, giving the quantity and value of fishery products landed by American fishing and collecting vessels at that port.

In 1920 the fishing fleet at Seattle landed 822 trips, aggregating 14,355,450 pounds of fish, having a value to the fishermen of \$1,992,759. This catch was taken from the various fishing grounds along the coast from Oregon to Portlock Bank, Alaska. The fishing areas from which the largest quantities of fish were obtained were Flattery Banks, west coast of Vancouver Island, and Hecate Strait. The products included halibut, 12,683,450 pounds, valued at \$1,913,849; sablefish, 950,200 pounds, valued at \$49,963; "lingcod," 513,035 pounds, valued at \$21,153; and rockfishes, 208,765 pounds, valued at \$7,794. Compared with the previous year there was an increase of 152 trips by fishing vessels, and of 704,430 pounds, or 5.16 per cent, in the quantity, and of \$462,475, or 30.22 per cent, in the value, of the products landed. The catch of halibut increased 1,572,730 pounds, or 14.15 per cent, in quantity, and \$491,330, or 34.53 per cent, in value, but there was a decrease in the catch of other species landed by fishing vessels. Sablefish decreased 603,400 pounds, or 38.83 per cent, in quantity, and \$24,327, or 32.74 per cent, in value; "lingcod," 209,965 pounds, or 29.04 per cent, in quantity, and \$3,280, or 13.42 per cent, in value; and rockfishes, 54,935 pounds, or 20.83 per cent, in quantity, and \$1,248, or 13.80 per cent, in value.

The fishery products taken in Puget Sound and landed at Seattle by collecting vessels during the year amounted to 9,813,966 pounds, valued at \$881,066. These products included salmon, 7,911,820 pounds, valued at \$765,145; herring, 345,100 pounds, valued at \$5,714; sturgeon, 1,860 pounds, valued at \$186; steelhead trout, 139,882 pounds, valued at \$19,094; smelt, 521,201 pounds, valued at \$29,795; perch, 47,520 pounds, valued at \$3,002; rockfishes, 130,200 pounds, valued at \$8,793; "lingcod," 44,904 pounds, valued at \$2,324; flounders, 86,065 pounds, valued at \$1,720; sole, 128,920 pounds, valued at \$4,475; and crabs, 456,494 pounds, valued at \$40,818. There was a decrease in the products landed by collecting vessels, compared with the previous year, of 1,995,484 pounds, or 16.89 per cent, in quantity, and \$102,753, or 10.44 per cent, in value.

This was due to a large falling off in the catch of salmon, amounting to 2,475,883 pounds, or 23.83 per cent, in quantity, and \$137,572, or 15.23 per cent, in value. The decrease in salmon was offset to some extent by a considerable increase in various less important species.

The following table and figure 5 present the most productive fishing grounds in the order of their importance visited by the fishing fleet at Seattle during the past five years, with the quantity of halibut and other species taken from these areas in 1920, and also the average production of these species for the 5-year period from 1916 to 1920, inclusive:

POUNDS OF HALIBUT AND OTHER FISH LANDED BY FISHING VESSELS AT SEATTLE, WASH., IN 1920, COMPARED WITH THE 5-YEAR AVERAGE, 1916 TO 1920, SHOWN BY FISHING GROUNDS.

Fishing grounds.	Halibut.	Other fish.	Total.
Hecate Strait:			
1920.....	4,645,300	208,300	4,853,600
5-year average.....	3,285,343	335,321	3,620,664
Flattery Banks:			
1920.....	2,661,000	806,500	3,467,500
5-year average.....	2,504,936	1,376,590	3,881,526
Vancouver Island (west coast):			
1920.....	1,873,600	387,800	2,261,400
5-year average.....	1,051,370	497,800	1,549,170
Portlock Bank:			
1920.....	952,050	1,600	953,650
5-year average.....	1,444,804	61,091	1,505,895
Yakutat grounds:			
1920.....	906,000	5,000	911,000
5-year average.....	2,137,458	95,531	2,232,989
All others:			
1920.....	1,645,500	262,800	1,908,300
5-year average.....	2,237,298	785,166	3,022,464

FISHING GROUNDS

MILLIONS OF POUNDS

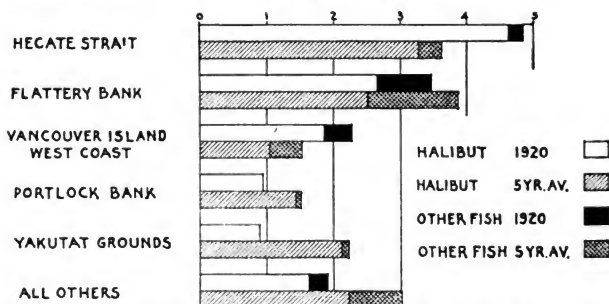


FIG. 5.—Quantities of halibut and other fish landed by fishing vessels at Seattle, Wash., in 1920, compared with the five-year average, 1916 to 1920, shown by fishing grounds.

The quantity and value of fishery products landed at Seattle by fishing and collecting vessels in 1920 are given in detail in the following table:

QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS (FRESH) LANDED AT SEATTLE, WASH., BY AMERICAN FISHING VESSELS, CALENDAR YEAR 1920.

	Number of trips.	Halibut.		Sablefish.	
		Pounds.	Value.	Pounds.	Value.
BY FISHING GROUNDS.					
Oregon coast.....	2	49,000	\$7,137		
Columbia River grounds.....	1	30,000	3,940	3,000	\$150
Grays Harbor grounds.....	13	218,000	32,892	153,000	7,650
Flattery Banks.....	326	2,661,000	421,536	421,100	22,440
West coast, Vancouver Island.....	166	1,873,600	318,092	210,900	11,888
Cape Scott grounds.....	18	198,900	27,966	4,000	200
Queen Charlotte Islands grounds.....	20	581,500	86,187	30,000	1,500
Hecate Strait.....	221	4,645,300	702,994	98,200	4,505
Forrester Island grounds.....	14	497,000	72,993	25,000	1,330
Cape Spencer.....	3	72,000	11,145		
Yakutat grounds.....	24	906,000	114,943	5,000	300
Portlock Bank.....	14	952,050	114,024		
Total.....	822	12,683,450	1,913,849	950,200	49,963
BY MONTHS.					
January.....	7	191,700	30,130	9,000	460
February.....	28	563,900	75,410	31,500	1,555
March.....	68	935,000	128,394	69,800	2,970
April.....	88	977,200	154,618	22,200	1,020
May.....	119	1,717,600	234,024	29,500	1,425
June.....	100	1,769,050	265,044	70,600	3,125
July.....	105	1,932,000	276,791	235,800	11,790
August.....	111	1,802,800	269,672	213,000	10,650
September.....	76	1,094,600	178,657	115,000	7,285
October.....	64	740,800	147,894	108,000	6,480
November.....	46	917,000	144,075	50,000	2,855
December.....	10	41,800	9,140	5,800	318
Total.....	822	12,683,450	1,913,849	950,200	49,963

	"Lingcod."		Rockfishes.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
BY FISHING GROUNDS.						
Oregon coast					49,000	\$7,137
Columbia River grounds.	2,009	\$60	1,000	\$30	36,000	4,180
Gray's Harbor grounds.	14,000	500	2,000	60	387,000	41,102
Flattery Banks.	298,365	12,491	87,035	3,453	3,467,500	459,920
West coast, Vancouver Island.	133,890	5,825	43,040	2,007	2,261,400	337,812
Cape Scott grounds.	6,500	130	3,300	66	211,800	28,362
Queen Charlotte Islands grounds.	8,000	300	6,000	180	625,500	88,167
Hecate Strait.	45,710	1,676	64,390	1,878	4,853,600	711,053
Forrester Island grounds.	3,000	140	2,000	120	527,000	74,583
Cape Spencer.					72,000	11,145
Yakutat grounds.					911,000	115,243
Portlock Bank.	1,690	31			953,650	114,055
Total	513,035	21,153	208,765	7,794	14,355,450	1,992,759
BY MONTHS.						
January	8,000	539			208,700	31,120
February	25,000	1,140	8,000	580	628,400	78,685
March	48,900	1,507	20,800	641	1,091,500	133,515
April	95,535	2,408	49,665	1,204	1,139,600	159,250
May	29,000	580	13,800	276	1,789,900	236,305
June	23,600	591	19,000	360	1,882,250	269,120
July	26,000	560	16,000	360	2,209,800	289,501
August	57,000	2,200	15,500	595	2,088,300	283,117
September	144,000	8,497	49,600	2,655	1,402,600	197,094
October	48,500	2,730	16,000	940	913,300	158,044
November	9,500	410	4,000	180	980,500	117,520
December					47,600	9,488
Total	513,035	21,153	208,765	7,794	14,355,450	1,992,759

FISHERY PRODUCTS, BY MONTHS, TAKEN IN PUGET SOUND AND LANDED AT SEATTLE, WASH., BY COLLECTING VESSELS, 1920.

Species.	January.		February.		March.		April.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Herring.....	42,000	\$2,440	144,000	\$1,440	55,000	\$550		
Salmon:								
Chum or keta.....	120,000	8,000					47,200	\$7,080
King or spring.....	14,000	1,400					60,000	9,000
Coho or silver.....								
Miscellaneous.....	4,000	400						
Trout: Steelhead.....							21,600	3,190
Smelt.....	55,000	2,200	56,000	1,960	20,000	1,600	25,000	3,000
Perch.....					5,100	357	8,200	432
Rockfishes.....	8,400	504	16,600	1,162	15,650	782	11,000	770
"Lingcod".....	6,000	300	12,000	720	8,000	400		
Flounders.....					12,600	252	6,880	137
Sole.....	21,600	840	28,000	700	20,000	800	14,000	560
Crabs.....	56,078	4,678	48,000	3,401	70,620	4,865	19,260	1,400
Total.....	327,078	20,762	304,600	9,473	206,970	9,606	213,140	25,586

Species.	May.		June.		July.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Sturgeon.....			1,860	\$186		
Herring.....			12,300	246	3,300	\$330
Salmon:						
Humpback or pink.....					31,750	1,065
Chum or keta.....					55,750	2,787
King or spring.....	248,000	\$34,720	803,450	112,483	860,980	103,311
Coho or silver.....			38,440	4,612	126,730	12,673
Sockeye or red.....			80,000	9,600	26,680	2,668
Miscellaneous.....	42,000	5,880				
Trout: Steelhead.....	24,000	3,360	29,660	3,559	5,300	530
Perch.....			6,320	379	4,000	240
Rockfishes.....	10,000	800	13,800	887	8,000	560
Flounders.....	9,600	192	17,500	350	10,600	212
Sole.....	15,000	600	9,640	289		
Total.....	348,600	45,552	1,012,970	132,601	1,133,040	124,919

Species.	August.		September.		October.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Herring.....	18,000	\$300				
Salmon:						
Humpback or pink.....	8,400	336				
Chum or keta.....	158,540	6,340	250,800	12,740	1,438,280	\$86,206
King or spring.....	805,800	107,496	320,150	35,216	69,540	7,144
Coho or silver.....	196,180	20,618	312,600	31,260	464,400	46,440
Sockeye or red.....	20,000	2,040				
Trout: Steelhead.....					2,590	259
Smelt.....	80,600	4,030	28,000	1,680	76,060	4,567
Perch.....			5,300	318	4,600	276
Rockfishes.....	12,000	840	10,150	710	10,000	600
Flounders.....			12,000	240	7,225	144
Sole.....	6,680	265				
Crabs.....					91,608	7,287
Total.....	1,396,200	142,206	949,999	82,264	2,154,903	153,043

Species.	November.		December.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Sturgeon.....					1,860	\$186
Herring.....					345,100	5,714
Salmon:			60,500	\$605		
Humpback or pink.....					40,150	2,241
Chum or keta.....	769,920	\$38,496	350,000	43,080	3,182,290	197,739
King or spring.....	12,600	1,764	8,000	1,280	3,269,670	411,884
Coho or silver.....	49,080	3,925	29,800	4,154	1,277,080	132,683
Sockeye or red.....					126,680	14,308
Miscellaneous.....					46,000	6,200
Trout: Steelhead.....	10,452	1,254	46,280	6,942	139,882	19,094
Smelt.....	106,142	6,368	72,800	4,360	521,201	29,785
Perch.....	14,000	980			47,520	3,002
Rockfishes.....	8,600	688	6,000	480	130,200	8,730
"Lingcod".....	12,424	645	6,480	259	44,904	2,324
Flounders.....	6,060	121	3,600	72	86,065	1,720
Sole.....			14,000	420	128,920	4,475
Crabs.....	79,200	11,880	91,728	7,217	1,456,494	40,818
Total.....	1,068,478	66,122	697,888	68,869	9,513,966	881,066

1 20,650 dozen.

FISHERY PRODUCTS RECEIVED AT MUNICIPAL FISH WHARF AND MARKET, WASHINGTON, D. C.⁶

The total receipts of fishery products at the Municipal Fish Wharf and Market, Washington, D. C., in 1920, were 8,573,984 pounds, a decrease of 2,159,102 pounds, or 20.11 per cent. as compared with 1919. The five most important products in terms of quantity were: Squeteagues or "sea trout," 1,925,334 pounds; oysters, 1,284,707 pounds, or 183,529 bushels; river herring, 1,068,660 pounds; shad, 1,035,822 pounds; and croaker, 743,415 pounds. These represent a total of 6,057,938 pounds, or 70.65 per cent of the entire receipts at this market for the year. Although differing in the order of their importance, these were the five principal species in 1919, representing 69.49 per cent of the entire receipts of the market for that year. The decrease in the total receipts of fish in 1920 as compared with the previous year is significant in view of the reported general decrease in the consumption of fishery products.

To supply local housewives with information as to species which are abundant in the Washington markets and seasons of abundance, the Bureau issued a post-card size fish calendar.

FISHERY PRODUCTS, IN POUNDS, RECEIVED AT MUNICIPAL FISH WHARF AND MARKET, WASHINGTON, D. C., 1920.

Species.	January.	February.	March.	April.	May.	June.	July.
Bas, black and sea.....	25,657	14,181	34,904	2,200	2,400	3,495	7,228
Bluefish.....	35	.....	.....	.....	800	10,950	550
Butterfish.....	500	.....	.....	1,300	15,700	40,300	59,850
Carp.....	4,270	13,471	14,533	10,295	17,909	9,654	4,954
Catfish.....	1,499	8,989	47,676	26,727	16,983	24,022	8,806
Cod.....	4,400	6,400	5,700	2,900	7,100	9,050	1,900
Croaker.....	480	800	101,100	218,919	89,397	120,712	96,263
Eels.....	.....	.....	355	2,155	998	673	338
Flounders.....	4,802	11,105	15,872	11,897	14,514	10,040	2,700
Gizzard shad.....	20,963	2,804	1,000	.....	.....	.....	.....
Haddock.....	6,967	43,450	26,200	3,420	2,750	3,100	1,300
Hake.....	2,500	.....	.....	.....	.....	.....	.....
Halibut.....	28,427	10,700	3,950	200	2,700	6,596	4,960
Herring.....	.....	.....	.....	.....	.....	.....	.....
River.....	72,400	80,200	276,256	539,671	99,221	112	.....
Sea.....	30,000	.....	.....	.....	.....	.....	.....
Hickory shad or "jacks".....	736	4,395	9,349	7,347	45	.....	.....
Kingfish.....	200	.....	.....	400	.....	.....	.....
Mackerel.....	50,090	1,400	2,012	8,400	17,200	37,635	2,470
Mullet.....	1,519	312	593	.....	150	.....	.....
Perch.....	2,400	11,002	71,167	25,459	10,303	4,994	3,976
Pickrel.....	200	.....	.....	.....	.....	.....	.....
Pike or pickerel.....	1,875	3,864	3,362	250	100	15	88
Pollock.....	2,700	1,800	4,100	2,000	600	1,000	900
Redfish or red drum.....	.....	200	400	400	.....	.....	.....
Salmon.....	6,558	.....	850	.....	.....	200	1,200
Scup or porgy.....	.....	.....	.....	.....	.....	1,000	1,500
Shad.....	1,400	21,842	184,625	685,268	118,602	1,100	.....
Shoephead.....	400	.....	400	.....	.....	.....	.....
Smelt.....	3,175	1,905	300	.....	.....	.....	.....
Stappers.....	.....	.....	.....	.....	.....	.....	6
Spot.....	300	.....	2,500	2,400	8,465	7,534	18,550
Squeteagues or "sea trout".....	27,785	8,000	15,460	44,687	443,997	199,800	210,297
Striped bass.....	4,100	3,349	12,712	28,478	113,505	19,249	12,841
Sturgeon.....	.....	.....	.....	1,600	1,331	.....	.....
Tilapia.....	.....	.....	.....	400	1,450	400	.....
Tilapia.....	.....	1,000	2,000	.....	.....	.....	.....
Whitefish.....	.....	.....	.....	100	.....	.....	.....
Whiting.....	48,550	23,000	50,780	.....	.....	.....	.....
Clams, hard.....	5,632	8,768	6,656	6,376	14,520	9,888	17,387

¹ Includes 100 pounds white bass.

⁶ Daily reports of the quantity of fishery products received at this market are received by the Bureau of tabulation through the courtesy of the Health Department of the District of Columbia.

FISHERY PRODUCTS, IN POUNDS, RECEIVED AT MUNICIPAL FISH WHARF AND MARKET, WASHINGTON, D. C., 1920—Continued.

Species.	January.	February.	March.	April.	May.	June.	July.
Oysters:							
In the shell.....	74,018	56,021	98,819	32,508	3,871	518	19
Opened.....	137,259	91,550	77,958	28,342	3,218		
Scallops.....	80	160	240	400			
Crabs.....				126	3,504	5,930	15,690
Crabs, oyster.....	100						
Crabmeat.....	2,455	2,240	2,620	1,530	4,093	2,960	6,650
Frogs.....				21	43	231	
Lobster.....	2,000						
Shrimp.....	1,945	1,190	400	24,000		250	
Turtles.....	1,245	990		6	177	285	215
Total.....	588,522	435,748	1,074,849	1,720,092	914,806	531,693	480,723

Species.	August.	September.	October.	November.	December.	Total.
Bass, black and sea.....	2,293	280	1,386	16,044	32,001	142,009
Bluefish.....	10,975	11,695	13,875	600	1,500	50,980
Butterfish.....	68,600	66,850	27,100	22,400		297,600
Carp.....	5,694	8,585	8,633	5,235	17,167	120,400
Catfish.....	8,402	10,296	15,082	14,053	10,501	192,136
Cod.....	2,400	4,100	1,400	4,800	10,380	60,530
Croaker.....	60,066	5,537	19,459	16,152	5,530	743,415
Eels.....	79	458	2,111	1,378	509	9,054
Flounders.....	3,175	7,351	13,004	15,680	7,334	117,390
Gizzard shad.....					6,600	40,427
Haddock.....	2,600	7,800	14,625	5,400	12,650	120,162
Hake.....				13,500	6,950	22,950
Hallbut.....	3,325	5,516	2,400	2,942	4,250	75,996
Herring:						
River.....					800	1,068,660
Sea.....						30,000
Hickory shad or "jacks".....						21,870
Kingfish.....						600
Mackerel.....	5,600	11,500	2,200	10,300	13,450	162,167
Mullet.....	81	119	678	1,875	3,084	8,411
Perch.....	5,764	2,878	4,886	12,571	9,390	165,542
Pigfish.....						200
Pike or pickerel.....	280	850	2,144	2,754	5,094	20,676
Pollock.....	2,400	2,300	1,400	2,700	10,150	32,050
Pompano.....		1,000				1,000
Redfish or red drum.....		675	40	3,100		4,815
Salmon.....	715	5,525	10,580	300		25,928
Scup or porgy.....						2,500
Shad.....		200	785	1,750	20,250	1,085,822
Sheepshead.....						800
Smelt.....					1,450	6,530
Snappers.....					85	118
Spot.....		36,395	32,480	7,200	1,800	137,487
Squeteagues or "sea trout".....	199,518	304,186	307,564	115,600	48,530	1,925,334
Striped bass.....	17,192	25,350	37,413	48,230	5,704	228,123
Sturgeon.....	53	107	107	200		3,291
Tilefish.....		900	5,300	1,700	900	11,050
Tullibee.....						3,000
Whitefish.....			100			210
Whiting.....				44,300	400	167,030
Clams, hard.....	8,864	5,871	4,526	1,760	1,344	91,392
Oysters:						
In the shell.....	323	3,588	103,898	164,374	147,539	685,671
Opened.....	413	30,116	52,431	82,436	95,313	599,036
Scallops.....						880
Crabs.....	15,550	24,213	6,525	375		71,913
Crabs, oyster.....						100
Crabmeat.....	7,290	2,700	135		45	32,718
Frogs.....						295
Lobster.....						2,000
Shrimp.....	50	400	815	437	298	29,753
Turtles.....	300	100	93			3,411
Total.....	455,865	587,361	683,175	620,152	480,998	8,573,954

¹ Includes 250 pounds smoked haddock.² Includes 600 pounds smoked haddock.³ 97,953 bushels. The oysters have been reduced to pounds on the basis of 7 pounds of meat to a bushel and 8½ pounds to a gallon⁴ 72,610 gallons.

SHAD FISHERY OF THE HUDSON RIVER.⁷

In 1920 there were 368 persons engaged in this fishery, an increase of 69 persons as compared with 1919. The investment amounted to \$40,351, which includes 185 rowboats, valued at \$10,011; 10 gasoline boats, valued at \$2,050; 200 gill nets, valued at \$23,710; 10 seines, valued at \$1,655; and shore and accessory property to the value of \$2,925.

The catch numbered 49,315 fish, or 199,844 pounds, valued at \$56,309. Of this quantity the number of shad taken on the New York side of the river was 39,692, or 157,715 pounds, valued at \$43,882, and on the New Jersey side, 9,623 shad, or 42,129 pounds, valued at \$12,427. The catch with gill nets was 47,444 shad, or 96.2 per cent of the total catch. The average number of shad taken per gill net was 237.

Compared with 1919 there was a decrease in the number of shad taken of 40,986, or 45.38 per cent, and of \$27,415, or 32.74 per cent, in the value. Compared with 1918 there was a decrease of 18,088, or 26.83 per cent, in the number of fish and an increase of \$1,131, or 2.34 per cent, in the value.

SHAD FISHERY OF THE HUDSON RIVER, 1920.

Item.	New York.			New Jersey.			Total.		
	Number.	Pounds.	Value.	Number.	Pounds.	Value.	Number.	Pounds.	Value.
Fishermen.....	352			16			368		
Rowboats.....	178		\$9,486	7		\$525	185		\$10,011
Gasoline boats.....	7		1,100	3		950	10		2,050
Gill nets.....	190		21,810	10		1,900	200		23,710
Seines.....	10		1,655				10		1,655
Shore and accessory property.....			1,925			1,000			2,925
Total.....			35,976			4,375			40,351
Shad caught:									
With gill nets.....	37,821	150,658	42,089	9,623	42,129	12,427	47,444	192,787	54,516
With seines.....	1,871	7,057	1,793				1,871	7,057	1,793
Total.....	39,692	157,715	43,882	9,623	42,129	12,427	49,315	199,844	56,309

SHAD AND ALEWIFE FISHERY OF THE POTOMAC RIVER.⁸

In 1920 there were 753 persons engaged in this fishery, using 451 boats, valued at \$83,889; 271 pound nets, valued at \$126,455; 211 gill nets and 1 haul seine, valued at \$39,620; and shore and accessory property to the value of \$1,375.

The catch of shad was slightly smaller than in 1919, numbering 529,358, or 1,979,780 pounds, valued at \$334,464. Of this quantity 80,944 shad, or 302,237 pounds, valued at \$55,963, were taken by Maryland fishermen and 448,414 shad, or 1,677,543 pounds, valued at \$278,501, by Virginia fishermen. The catch of river herring by Maryland fishermen numbered 1,077,775, or 538,888 pounds, valued at \$13,940, and by Virginia fishermen 7,681,561, or 3,813,780 pounds, valued at \$41,197, the total catch being 8,759,336, or 4,352,668 pounds, valued at \$55,137. This represents a decrease of 108,566 in number and \$5,879 in the value as compared with 1919.

⁷ The canvass of this fishery was made by Rob Leon Greer, Statistical Agent, U. S. Bureau of Fisheries.

⁸ The canvass of this fishery was made by G. W. Hootnagle, apprentice fish-culturist, Edenton, N. C.

SHAD AND ALEWIFE FISHERY OF THE POTOMAC RIVER, 1920.

Item.	Maryland.			Virginia.			Total.		
	Number.	Pounds.	Value.	Number.	Pounds.	Value.	Number.	Pounds.	Value.
Fishermen.....	204			549			753		
Rowboats.....	87		\$3,225	118		\$4,047	205		\$7,272
Gasoline.....	28		6,620	218		69,997	246		76,617
Pound nets.....	71		19,369	200		116,095	271		135,465
Gill nets and seines ¹	66		13,800	146		25,820	212		39,620
Shore and accessory property.....			300			1,079			1,379
Total.....			34,305			217,034			251,339
Shad caught:									
With pound nets and traps.....	7,144	20,487	4,263	356,552	1,326,923	211,039	363,696	1,353,410	215,302
With gill nets and seines ¹	73,800	275,750	51,700	91,862	350,620	67,462	165,662	626,370	119,162
Total.....	80,944	302,237	55,963	448,414	1,677,543	278,501	529,358	1,979,780	334,464
Alewives caught:									
With pound nets and traps.....	757,775	378,888	7,540	7,477,561	3,711,780	37,117	8,235,336	4,090,688	44,637
With gill nets and seines ¹	320,000	160,000	6,400	204,000	102,000	4,080	524,000	262,000	10,480
Total.....	1,077,775	538,888	13,940	7,681,561	3,813,780	41,197	8,759,336	4,352,688	55,117

¹ Includes 1 haul seine, with the catch, operated in Maryland.

FISH, FROZEN.

COLD-STORAGE HOLDINGS DURING 1920.

Beginning with October 15, 1917, the Bureau of Markets of the Department of Agriculture has issued monthly mimeographed reports of the storage holdings of frozen and cured fish and also a bulletin (No. 792) for holdings in 1918, in which the storage holdings are presented in diagrammatic form with discussions and tables. Brief summaries of holdings of frozen fish have appeared in *The Market Reporter*, published weekly by the same bureau. During 1920 the monthly mimeographed memoranda have contained the storage holdings on the fifteenth of the month by species, comparisons of holdings with other months, quantities frozen and quantities delivered since the fifteenth of previous month, comparisons with holdings at fifteenth of previous month, and storage holdings by geographic sections.

Appended is a summary of the holdings by species and by months for 1920, including totals for 1918 and 1919, which have been compiled from the reports of the Bureau of Markets:

COLD-STORAGE HOLDINGS OF FROZEN FISH, BY SPECIES FOR 1920, AND BY TOTALS FOR 1919 AND 1918,¹ GIVEN IN POUNDS.

Species.	Jan. 15.	Feb. 15.	Mar. 15.	Apr. 15.	May 15.	June 15.
Bluefish.....	301,383	232,912	135,296	91,190	108,967	219,124
Butterfish.....	459,374	334,741	253,706	206,915	181,621	200,877
Ciscoes.....	4,302,545	3,281,821	1,868,346	1,173,570	802,401	596,535
Cod, hake, pollock, and haddock.....	3,923,930	2,901,850	1,721,706	1,480,928	1,405,403	1,856,260
Croaker.....	82,314	37,952	10,528	31,111	33,944	64,023
Halibut.....	7,788,546	5,375,287	3,991,261	3,091,887	4,155,392	5,726,088
Herring.....	9,303,418	6,507,254	3,732,770	2,010,888	2,205,187	3,305,773
Lake trout.....	1,229,998	821,392	315,003	91,298	251,947	411,660
Mackerel.....	2,339,005	2,102,720	1,200,358	735,773	1,056,182	1,758,346
Rockfishes.....	400,880	290,888	234,771	178,661	139,704	162,537
Sablefish.....	1,354,336	765,428	508,469	306,910	253,414	177,546
Salmon.....	5,701,129	4,516,290	2,921,559	1,996,938	1,739,342	1,871,337
Sea bass.....	109,354	81,105	50,417	40,402	50,480	69,959
Shad.....	541,315	309,024	133,079	147,239	177,391	419,393
Shad roe.....	14,252	12,374	5,846	18,446	16,094	46,326
Smelt, eulachon, etc.....	610,700	689,722	387,922	202,832	142,963	110,246
Squeteague.....	439,011	291,179	95,709	57,188	38,462	123,598
Squid.....	422,208	282,791	183,922	95,895	93,745	517,814
Whitefish.....	2,220,140	1,064,065	1,371,491	822,721	381,594	287,471
Whiting.....	9,319,624	6,864,067	3,470,088	2,287,080	1,332,930	2,374,659
Miscellaneous.....	10,635,659	10,292,863	6,775,413	5,501,952	5,717,307	7,428,240
Total, 1920.....	61,499,121	47,962,625	29,379,676	20,569,824	20,284,470	27,730,842
Total, 1919.....	80,844,524	66,675,012	49,889,032	37,110,856	37,068,407	47,370,741
Total, 1918.....	49,562,848	35,907,071	28,457,301	26,548,472	31,103,425	50,298,027

Species.	July 15.	Aug. 15.	Sept. 15.	Oct. 15.	Nov. 15.	Dec. 15.
Bluefish.....	153,286	240,881	283,771	303,195	402,451	411,000
Butterfish.....	283,174	507,992	515,035	933,513	1,353,337	1,199,000
Ciscoes.....	620,704	2,152,253	4,968,638	6,306,065	6,045,595	6,533,000
Cod, hake, pollock, and haddock.....	1,690,735	2,113,959	2,577,701	3,040,676	3,785,894	3,538,000
Croaker.....	108,777	281,429	108,882	706,404	703,811	577,000
Halibut.....	6,609,561	8,629,889	10,340,381	10,661,832	9,761,076	8,691,000
Herring.....	5,342,182	5,480,143	5,430,419	6,083,108	6,582,737	7,738,000
Lake trout.....	493,036	554,365	551,590	953,691	1,675,026	2,108,000
Mackerel.....	3,064,809	3,014,641	2,677,822	2,620,092	2,788,666	2,405,000
Rockfishes.....	124,330	185,228	199,928	200,548	215,944	143,000
Sablefish.....	283,333	596,683	834,172	1,118,903	1,019,398	919,000
Salmon.....	2,593,381	3,467,706	4,676,152	6,771,546	8,094,984	7,128,000
Sea bass.....	85,493	121,771	109,134	106,504	123,598	130,000
Shad.....	433,773	473,731	502,435	493,731	175,701	310,000
Shad roe.....	62,328	49,416	42,973	41,984	41,772	42,000
Smelt, eulachon, etc.....	88,826	100,968	115,625	162,557	162,197	182,000
Squeteague.....	460,703	449,301	498,421	861,561	1,007,848	812,000
Squid.....	699,532	865,924	2,102,909	2,580,377	2,625,801	2,226,000
Whitefish.....	331,269	623,567	1,015,279	1,500,929	1,089,815	1,985,000
Whiting.....	4,395,069	8,630,018	9,648,503	9,536,391	9,412,377	7,811,000
Miscellaneous.....	7,928,975	8,563,480	8,439,277	9,854,135	10,459,900	10,466,000
Total, 1920.....	35,793,280	47,073,315	55,692,370	64,437,745	67,827,934	65,387,000
Total, 1919.....	59,363,929	64,740,173	69,551,969	76,138,809	78,477,501	73,936,025
Total, 1918.....	64,859,532	82,773,229	89,557,970	94,411,718	99,631,789	96,600,247

¹ The 1918 totals are taken from "Reports of Storage Holdings of Certain Food Products during 1918," by John O. Bell, U. S. Department of Agriculture Bulletin No. 792, and the 1919 and 1920 holdings from the mimeographed memoranda issued monthly by the Bureau of Markets.

QUANTITIES FROZEN IN 1920.

The quantities of fish frozen between January 15, 1920, and January 15, 1921, based on the monthly memoranda issued by the Bureau of Markets was 85,324,366 pounds. The principal varieties frozen were as follows: Halibut, 10,625,029 pounds; herring, 10,356,305 pounds; whiting, 10,208,755 pounds; salmon, 7,836,620 pounds; ciscoes, 6,968,750 pounds; mackerel, 4,835,173 pounds; cod, haddock, hake, and pollock, 3,940,163 pounds; and squid, 3,252,720 pounds. The item of miscellaneous fishes amounted to

16,454,317 pounds and includes albacore, bonito, burbot, catfish, eels, flounders, German and buffalo carp, horse mackerel, Spanish mackerel, perch, pike, pickerel, pompano, red snapper, sheepshead, swordfish, tilefish, tuna, all kinds of fresh and salt water bass except sea bass, and all other frozen fish including soft crabs and bay scallops. The item of frozen shad of 411,398 pounds includes 31,063 pounds of shad roe. Figure 6 shows the relative amounts of each species frozen.

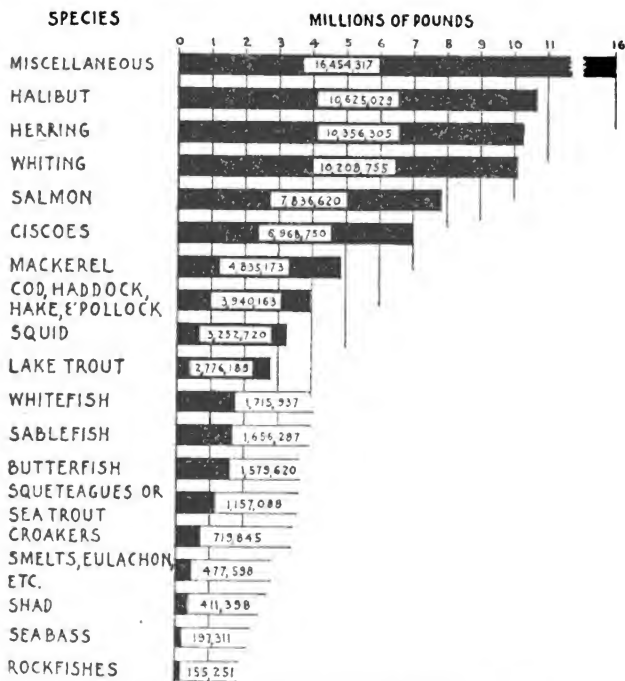


FIG. 6.—Quantiles of fish frozen during 1920, shown by species.

FISHERIES OF CALIFORNIA IN 1920.

Through the courtesy of the California State Fish and Game Commission the Bureau has received copies of its monthly sheets showing the catch of fish by species and by localities for the calendar year 1920. In the appended table, page 57, these figures have been compiled by months and by species, such an arrangement being of value in ascertaining seasonal variation in catch. There has also been added a table, page 59, of the imports of fresh fish from Mexico to California centers during 1920.

COMMON AND SCIENTIFIC NAMES OF FISHES.

To provide a clearer understanding of the species to which reference is made in the tables and discussions, the following list of common and scientific names of the fishes of California, as accurately as it has been possible to ascertain them, is appended. As the reports do not in all cases distinguish between albacore and the species of tuna it is impracticable to separate the catch by species. Under flounders have been grouped the "bastard halibut" (*Paralichthys californicus*), the "turbot" (*Hypsopsetta guttulata*), sand dabs (*Citharichthys sordidus*), and a number of flounders locally designated as soles. The "hake" (*Merluccius productus*) of the west coast is closely related to the New England whiting, being a member of the same genus, and the adoption of the latter name would avoid confusion. *Menticirrhus undulatus* is designated as surffish, kingfish, and California whiting by the fishermen, and *Genyonemus lineatus*, another species belonging to the family of croakers, is commonly called kingfish. On the Atlantic seaboard the Bureau has recommended the adoption of the name king whiting for species of *Menticirrhus*. The "lingcod" is called cultus-cod on the California coast. Included with the catch of rockfishes are boccaccio (*Sebastes paucispinis*) and chilipepper (*S. goodei* and *jordani*). The young of the white sea bass (*Cynoscion nobilis*) are designated as "sea trout" and the species of sharks as grayfish by the fishermen.

Albacore and tuna.....	{ <i>Germo alalunga</i> . <i>Germo macropterus</i> . <i>Thunnus thynnus</i> . Engraulis (species). Anchovialla (species).
Anchovies.....	<i>Sphyræna argentea</i> .
Barracuda.....	<i>Cynoscion parvipinnis</i> .
Bluefish, California, or squeteague.....	<i>Sarda chilensis</i> .
Bonito or skipjack.....	<i>Cyprinus carpio</i> .
Carp.....	Ameiurus (species).
Catfish.....	{ <i>Lycodontis mordax</i> . <i>Murena</i> (species).
Eels.....	Pleuronectidae (species).
Flounders.....	<i>Girella nigricans</i> .
Greenfish or rudderfish.....	<i>Merluccius productus</i> .
"Hake".....	<i>Orthodon microlepidotus</i> .
Hardhead.....	<i>Clupea pallasii</i> .
Herring.....	<i>Genyonemus lineatus</i> .
Kingfish.....	<i>Ophiodon elongatus</i> .
"Lingcod".....	<i>Scomber japonicus</i> .
Mackerel.....	<i>Mugil cephalus</i> .
Mullet.....	Embiotocidae (species).
"Perches," surf.....	<i>Ptychocheilus oregonensis</i> .
Pike, Sacramento.....	<i>Sardinia caerulea</i> .
Pilchard.....	<i>Palometa simillima</i> .
Pompano, California.....	{ <i>Sebastes</i> (species). <i>Sebastichthys</i> (species).
Rockfishes.....	<i>Anoplopoma fimbria</i> .
Sablefish.....	<i>Oncorhynchus</i> (species).
Salmon.....	<i>Scorpana guttata</i> .
Sculpin.....	<i>Stereolepis gigas</i> .
Sea bass, black.....	{ <i>Paralabrax clathratus</i> . <i>Paralabrax maculatofasciatus</i> . <i>Paralabrax nebulifer</i> .
Sea basses or "rock bass".....	<i>Cynoscion nobilis</i> .
Sea bass, white or squeteague.....	<i>Alosa sapidissima</i> .
Shad.....	All Selachii except Batoidei.
Sharks.....	

Sheepshead.....	{ <i>Anisotremus davidsonii</i> . <i>Caulolatilus princeps</i> . <i>Pimelometopon pulcher</i> . <i>Raja</i> (species).
Skates.....	{ <i>Platyrhinoides triseriatus</i> . <i>Rhinobatus productus</i> . <i>Atherinidae</i> (species).
"Smelt".....	<i>Pogonichthys macrolepidotus</i> .
Splittail.....	<i>Salmo gairdneri</i> .
Steelhead trout.....	<i>Roccus lineatus</i> .
Striped bass.....	{ <i>Dasyatis dipterura</i> . <i>Pteroplatea marmorata</i> . <i>Urophycis halleri</i> . <i>Myliobatis californicus</i> . <i>Catostomus occidentalis</i> . <i>Menticirrhus undulatus</i> . <i>Xiphias gladius</i> . <i>Microgadus proximus</i> . Small fry of any fish.
Stingarees or stingrays.....	<i>Caulolatilus princeps</i> . <i>Seriola dorsalis</i> .
Suckers.....	<i>Cancer magister</i> .
Surffish.....	{ <i>Crago franciscorum</i> . <i>Crago nigricauda</i> . <i>Crago nigrimaculata</i> .
Swordfish.....	<i>Panulirus interruptus</i> .
Tomcod.....	<i>Ilaliotis</i> (species).
Whitebait.....	<i>Tivela stultorum</i> .
Whitefish.....	<i>Mya arenaria</i> .
Yellowtail.....	<i>Cardium</i> (species).
Crabs.....	<i>Gastropoda</i> (species).
Shrimps.....	{ <i>Mytilus californianus</i> . <i>Mytilus edulis</i> .
Sea crawfish or spiny lobster.....	<i>Ostrea virginica</i> .
Abalones.....	<i>Ostrea lurida</i> .
Clams:	
Hard.....	<i>Pecten aquiculatus</i> .
Soft.....	<i>Gastropoda</i> (species).
Cockles.....	<i>Polypus hongkongensis</i> .
Limpets.....	<i>Loligo opalescens</i> .
Mussels.....	
Oysters:	
Eastern.....	
Native.....	
Scallops.....	
Snails.....	
Octopus.....	
Squid.....	

PRODUCTS.

The total yield of the fisheries of California in 1920 amounted to 212,635,075 pounds. The principal products were as follows: Pilchards, 118,517,729 pounds; albacore and tuna, 36,144,340 pounds; salmon, 11,077,014 pounds; bonito or skipjack, 8,614,581 pounds; flounders, 7,792,626 pounds; rockfishes, 5,503,187 pounds; and barracuda, 4,584,476 pounds. These products represent a total of 192,233,953 pounds, or 90.40 per cent of the total quantity credited to the State. The catch of shad amounted to 1,408,980 pounds; of sharks, skates, and rays to 1,253,648 pounds; of shrimp to 818,042 pounds; of squid to 507,751 pounds; of sea crawfish or spiny lobster to 247,156 pounds; of oysters to 148,924 pounds or 21,275 bushels; of octopus to 70,740 pounds; and of cockles to 18,054 pounds.

The imports of fresh fish from Mexico in 1920 amounted to 8,121,225 pounds. The principal products imported were as follows: Barracuda, 3,615,947 pounds; flounders, 1,678,264 pounds; sea crawfish or spiny lobster, 942,020 pounds; tuna, 724,281 pounds; white sea bass, or squeteague, 252,462 pounds; yellowtail, 218,400 pounds; and bonito or skipjack, 216,344 pounds.

PRODUCTS, IN POUNDS, OF THE FISHERIES OF CALIFORNIA, 1920.

Species.	January.	February.	March.	April.	May.	June.	July.
Albacore and tuna....	14,984	1,603	2,237		105	929,837	14,609,950
Anchovies.....	4,572	19,391	225	27,455	53,890	70,380	48,050
Barracuda.....	28,076	97,739	304,845	1,189,488	995,456	703,632	300,687
Bluefish, California, or squeteague.....	9,480	5,049	2,079				
Bonito or skipjack.....	32,261	25,711	21,133	1,165	5,644	2,457	44,330
Carp.....	15,458	19,772	43,513	21,972	14,685	3,224	7,177
Catfish.....	5,599	7,532	20,880	37,464	19,533		
Flounders.....	737,500	847,813	849,875	755,276	1,018,631	641,780	689,247
Greenfish or rudder- fish.....		412					
"Hake".....	5,500	2,030	3,170	6,527	13,138	17,860	14,510
Hardhead.....	2,753	3,565	4,688	1,380			
Herring.....	76,632	89,707	59,177	810			
Kingfish.....	125,104	18,269	46,779	85,637	58,502	16,742	7,774
"Lingcod".....	160,109	45,729	52,324	19,332	37,203	37,140	90,166
Mackerel.....	104,689	176,424	75,667	466,318	242,550	270,228	136,205
Mullet.....	15,912	29	80			55	110
"Perches," surf.....	12,102	13,299	34,658	39,177	5,027	1,531	12,152
Pike, Sacramento.....	1,074	1,488	1,327	1,380	299	22	5
Pilchard.....	23,776,733	21,190,860	10,715,798	3,910,008	2,466,602	2,405,151	2,567,451
Pompano, California.....	2,523	2,607	6,435	6,250	1,880	689	594
Rockfishes.....	570,541	931,615	605,478	284,722	408,009	331,287	374,930
Sablefish.....	89,953	124,923	135,689	66,933	32,252	54,433	40,538
Salmon.....	27,048	70,042	238,160	783,721	1,108,955	1,007,138	2,648,203
Sculpin.....	2,887	515	2,866	3,978	7,882	1,076	419
Sea bass, black.....	5,533	6,031	14,565	19,284	3,085	5,418	7,935
Sea basses or "rock bass".....	3,282	4,390	4,240	5,908	7,435	47,245	30,719
Sea bass, white or squeteague.....	15,423	285,230	109,340	364,401	313,808	256,675	200,232
Shad.....	925	3,093	91,529	597,259	713,905		
Sharks.....	65,142	141,428	15,105	44,727	141,749	113,439	64,429
Sheepshead.....	4,199	4,396	65	1,088	56	7	370
Skates.....	13,434	5,819	23,907	6,777	3,480	7,262	1,719
"Smelt".....	41,990	62,209	83,963	48,441	50,942	34,363	70,268
Split-tail.....	3,653	3,553	4,869	514			
Steelhead trout.....			10				740
Striped bass.....	57,834	35,668	90,722	153,677	140,957	1,804	
Stingarees or sting- rays.....				70,760	125,857	94,670	53,646
Suckers.....	695	444	429	563	30		
Surflish.....				10			
Swordfish.....	24					163	673
Tomcod.....	5,582	9,493	5,430	15	2,245	6,522	2,286
Whitebait.....		31	37	10	89	29	
Whitefish.....	1,092	1,738	571	6			
Yellowtail.....	55,943	20,497	189,208	231,788	216,719	173,808	48,404
Other fish.....	18,623	37,977	26,295	6,997	16,700	9,148	14,151
Crabs.....	307,780	146,542	104,038	73,018	161,106	55,132	6,292
Shrimps.....	68,204	52,545	62,147	117,711	90,569	42,729	86,606
Sea crawfish or spiny lobster.....	44,685	43,166					
Abalones.....	13,088		30,362	53,535	75,145	96,588	150,285
Clams.....	41,226	39,725	40,677	49,035	43,999	51,675	59,951
Cockles.....	2,218	2,708	4,385	2,240	1,913	1,601	320
Limpets.....		55	480	1,200	1,400	7,900	3,900
Mussels.....	1,082	1,352	3,747	2,066	3,413	10,505	6,847
Oysters: Eastern.....	9,909	9,344	6,040	7,974	6,205	4,629	4,200
Native.....	5,230	4,325	5,075	6,460	11,742	8,178	19,150
Scallops.....	50	246	217	212	34		
Snails.....	273	280					
Octopus.....	11,706	14,432	6,640	8,599	5,784	5,778	5,122
Squid.....	67,524	195,039	119,920		6,824	86,882	9,795
Total.....	26,687,519	24,827,820	14,271,086	9,583,289	8,635,444	7,706,821	22,431,658

PRODUCTS, IN POUNDS, OF THE FISHERIES OF CALIFORNIA, 1920—Continued.

Species.	August.	September.	October.	November.	December.	Total.
Albacore and tuna.....	14,819,308	3,801,885	1,954,324	8,948	1,159	36,144,540
Anchovies.....	16,485	199,577	87,561	28,405	14,605	570,686
Barracuda.....	219,553	308,809	285,362	53,022	97,717	4,584,476
Bluefish, California, or squeteague.....	54	.....	6,724	6,045	2,798	32,229
Bonito or skipjack.....	3,058,975	3,784,239	1,474,619	112,557	51,490	18,614,581
Carp.....	340	150	362	1,614	6,213	134,420
Catfish.....	1,367	2,173	3,014	9,631	4,872	112,368
Eels.....	.....	.....	180	.....	.....	180
Flounders.....	563,746	515,164	371,617	389,434	412,453	7,792,638
Greenfish or rudderfish.....	.....	.....	.....	.....	.....	412
"Hake".....	7,110	14,079	16,207	29,925	11,925	141,681
Hardhead.....	470	.....	.....	.....	.....	13,323
Herring.....	.....	.....	.....	.....	.....	274,364
Kingfish.....	3,442	8,728	23,477	30,989	35,968	461,411
"Lingcod".....	72,105	47,725	50,019	45,847	30,246	687,864
Mackerel.....	306,088	383,946	396,474	188,653	340,066	2,907,268
Mullet.....	980	347	.....	.....	.....	17,513
"Perches" surf.....	2,121	2,590	17,105	14,784	26,585	181,131
Pike, Sacramento.....	62	12	.....	899	1,570	30,126
Pilchard.....	13,130,346	14,163,753	11,102,753	8,990,053	4,098,151	118,517,729
Pompano, California.....	75	858	6,436	1,060	719	5,503,187
Rockfishes.....	298,448	285,248	321,742	421,234	609,933	781,032
Sablefish.....	45,386	9,233	67,814	86,772	27,106	11,077,014
Salmon.....	2,862,287	1,879,429	152,691	172,114	37,226	35,674
Sculpin.....	22	1,610	7,451	2,367	5,441	89,889
Sea bass, black.....	4,215	4,784	6,552	7,026	.....	207,075
Sea basses or "rock bass".....	28,742	27,715	23,665	12,059	11,675	2,376,293
Sea bass, white or squeteague.....	443,558	263,553	42,526	45,651	35,896	1,408,980
Shad.....	1,169	188	.....	639	282	798,721
Sharks.....	45,319	39,153	30,411	41,154	56,662	14,422
Sheepshead.....	280	107	877	1,627	1,990	85,931
Skates.....	437	6,774	1,020	6,650	11,652	730,475
"Smelt".....	59,727	76,895	77,129	82,057	42,491	14,084
Split-tail.....	.....	23	.....	288	1,154	6,999
Steelhead trout.....	5,160	.....	.....	425	.....	671,731
Striped bass.....	39,701	48,080	.....	37,204	66,084	365,996
Stingarees or stingrays.....	14,195	5,383	.....	287	820	2,712
Suckers.....	.....	.....	264	.....	.....	12,240
Surfscabbard.....	2,600	5,812	2,598	370	.....	37,237
Swordfish.....	606	128	.....	1,884	3,046	735
Tomcod.....	.....	.....	.....	147	387	7,419
Whitebait.....	90	.....	20	1,517	2,385	2,475,283
Whitefish.....	108,582	250,128	632,753	463,334	84,119	256,938
Yellowtail.....	18,921	6,082	28,988	54,002	19,054	1,115,862
Other fish.....	.....	.....	.....	96,074	165,880	818,012
Crabs.....	82,015	141,048	32,955	24,148	17,275	247,156
Shrimps.....	.....	.....	40,509	68,861	49,935	806,718
Sea crawfish or spiny lobster.....	105,061	59,365	55,859	95,430	71,998	568,405
Abalones.....	42,245	58,659	51,662	45,370	44,181	18,064
Clams.....	350	167	75	76	1,801	18,835
Cockles.....	3,900	.....	.....	.....	.....	32,710
Mussels.....	3,070	139	140	224	125	.....
Oysters.....	.....	.....	.....	.....	.....	.....
Eastern.....	5,229	6,751	8,976	8,997	10,839	59,741
Native.....	4,594	2,082	1,575	330	.....	789
Scallops.....	.....	.....	175	.....	.....	789
Snails.....	.....	.....	2,199	3,207	2,796	70,740
Octopus.....	.....	375	.....	322	53	507,751
Squid.....	21,292	.....	.....	.....	.....	.....
Total.....	36,454,270	26,413,036	17,297,606	11,693,776	6,632,750	212,635,075

¹ This item may include some striped tuna.² 50,721 in number.³ 5,096,182 in number.

MEXICAN FISHERY PRODUCTS, IN POUNDS, IMPORTED INTO CALIFORNIA, 1920.

Species.	January.	February.	March.	April.	May.	June.	July.
Barracuda.....	651,055	480,903	608,706	21,604	.....	.....	1,615
Bonito or skipjack.....	106,050	31,085	1,955	10,844	.....	.....	.....
Flounders.....	104,988	160,078	87,377	61,529	48,180	12,980	100,674
Mackerel.....	28,056	3,450	745	515	.....	.....	.....
"Perches," surf.....	40	250	.....	.....	.....	.....	.....
Pilchard.....	.....	.....	3,185	.....	.....	.....	.....
Pompano, California.....	80	89	62	.....	.....	.....	.....
Rockfishes.....	2,210	80,099	1,620	.....	.....	170	.....
Sea basses or "rock bass".....	125	190	315	.....	.....	210	.....
Sea bass, black.....	8,063	9,757	9,398	550	.....	.....	2,412
Sea bass, white, or squeteague.....	23,900	23,343	5,478	3,505	1,560	4,780	26,497
Sharks.....	.....	.....	12,628	.....	.....	.....	.....
"Smelt".....	39	.....	24,885	.....	.....	.....	.....
Stingarees or stingrays.....	.....	.....	.....	.....	.....	.....	.....
Swordfish.....	.....	.....	.....	.....	.....	273	.....
Tuna.....	.....	.....	.....	122,316	375,647	.....	.....
Whitefish.....	.....	2,137	2,280	.....	.....	.....	.....
Yellowtail.....	24,517	14,793	29,528	15,845	.....	5,045	915
Other fish.....	630	.....	.....	.....	.....	.....	.....
Sea crawfish or spiny lobster.....	77,440	103,508	136,008	131,030	118,408	71,305	.....
Abalones.....	20,200	.....	9,750	1,569	.....	.....	16,642
Clams.....	12,900	5,600	.....	4,827	.....	2,230	.....
Turtles.....	.....	.....	2,180	.....	.....	38,399	34,039
Total.....	1,060,243	915,282	936,100	374,074	543,795	135,392	182,794

Species.	August.	September.	October.	November.	December.	Total.
Barracuda.....	147,511	173,622	531,107	543,124	456,700	3,615,947
Bonito or skipjack.....	798	11,028	18,539	20,038	16,007	216,344
Flounders.....	229,603	297,907	432,770	106,278	35,950	1,678,264
Kingfish.....	.....	.....	48	.....	.....	48
Mackerel.....	1,012	5,230	8,805	390	1,539	50,732
Mullet.....	90	.....	.....	.....	.....	90
"Perches," surf.....	.....	.....	30	670	4,230	5,240
Pilchard.....	.....	.....	.....	.....	.....	3,185
Pompano, California.....	.....	.....	.....	.....	.....	231
Rockfishes.....	1,745	885	1,733	9,009	190	97,661
Sea basses or "rock bass".....	.....	485	75	1,090	815	3,305
Sea bass, black.....	1,858	2,018	6,923	4,397	12,792	58,168
Sea bass, white, or squeteague.....	90,245	41,414	20,360	9,174	2,206	252,462
Sharks.....	.....	165	.....	.....	.....	12,628
Sheepshead.....	.....	171	.....	.....	.....	165
"Smelt".....	500	.....	966	6,396	5,640	13,712
Stingarees or stingrays.....	.....	.....	.....	.....	.....	24,885
Swordfish.....	.....	200,415	16,279	.....	9,625	273
Tuna.....	.....	.....	.....	435	.....	724,281
Whitefish.....	.....	.....	.....	.....	.....	4,852
Yellowtail.....	3,952	26,870	48,535	43,140	5,260	218,400
Other fish.....	.....	.....	.....	.....	.....	630
Sea crawfish or spiny lobster.....	.....	22,443	90,590	105,330	85,958	942,020
Abalones.....	11,287	7,367	19,317	6,651	2,387	95,110
Clams.....	.....	2,300	.....	.....	.....	25,557
Turtles.....	.....	.....	.....	.....	.....	76,918
Total.....	489,501	792,500	1,196,123	856,122	639,299	8,121,225

FISHERIES OF THE SOUTH ATLANTIC STATES IN 1918.

The statistics of the fisheries contained in this report apply to the commercial coast fisheries of North Carolina, South Carolina, Georgia, and the eastern coast of Florida for the calendar year, 1918.⁹ The results of a similar canvass of the fisheries of the Gulf States in 1918, including the western coast of Florida, are included in "Fishery Industries of the United States. Report of the Division of Statistics and Methods of the Fisheries for 1919," pages 129 to 191.

⁹ The data were collected by Winthrop A. Roberts and Rob Leon Greer, assisted in North Carolina by Arthur Orr, E. M. Haynes, and G. W. Hooftagle.

EARLIER PUBLICATIONS.

Some of the earlier publications relating to the fisheries of the South Atlantic States and published in Washington, D. C., follow:

1887. North Carolina and Its Fisheries. By R. Edward Earll. *In The Fisheries and Fishery Industries of the United States*, by G. Brown Goode et al., Sec. II, Pt. XII, p. 475-497.
The Fisheries of South Carolina and Georgia. By R. Edward Earll. *Ibid.*, Sec. II, Pt. XIII, p. 499-518.
Eastern Florida and Its Fisheries. By R. Edward Earll. *Ibid.*, Sec. II, Pt. XIV, p. 519-531.
History and Methods of the Fisheries. *Ibid.*, Sec. V, Vol. I (xi+808 p.), Vol. II (xx+881 p.), and atlas of 275 pls.
1892. V. The Fisheries of the South Atlantic States [1887 and 1888]. *In Statistical Review of the Coast Fisheries of the United States*, prepared under the direction of J. W. Collins. Report, U. S. Commission of Fish and Fisheries, 1888 (1892), p. 351-361.
1893. Report on the Fisheries of the South Atlantic States. By Hugh M. Smith. Bulletin, U. S. Fish Commission, Vol. XI, 1891 (1893), p. 269-356, Pl. XLIII-LXXIV.
1897. Report on the Fisheries of Indian River, Florida. By John J. Brice et al. Report, U. S. Commission of Fish and Fisheries, 1896 (1898), p. 223-262, pl. 23-59.
1898. Report on the Fish and Fisheries of the Coastal Waters of Florida. By John J. Brice. Report, U. S. Commission of Fish and Fisheries, 1896 (1898), p. 263-342.
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The Shad Fisheries of the Atlantic Coast of the United States. By Charles H. Stevenson. *Ibid.*, p. 101-176.
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COMMON AND SCIENTIFIC NAMES OF FISHES.

In the appended list are given the common and scientific names of the species of fishes of the South Atlantic States listed in the statistical tables, as accurately as it has been practicable to determine them, for the guidance of the reader.

Alewives.....	{ <i>Pomolobus astivalis</i> .
Amberfish.....	{ <i>Pomolobus pseudoharengus</i> .
Angelfish.....	<i>Seriola</i> (species).
Barracuda.....	<i>Chetodipterus faber</i> .
	<i>Sphyrna</i> (species).
Black bass.....	{ <i>Micropterus dolomieu</i> .
	{ <i>Micropterus salmoides</i> .
Bluefish.....	<i>Pomatomus saltatrix</i> .
Blue runner or hardtail.....	<i>Caranx crysos</i> .
Bonito.....	<i>Sarda sarda</i> .
Bowfin.....	<i>Amiatus calvus</i> .
Butterfish.....	<i>Poronotus triacanthus</i> .
Carp.....	<i>Cyprinus carpio</i> .
Catfish.....	<i>Siluridae</i> (species).
Cero and kingfish.....	{ <i>Scomberomorus cavalla</i> .
	{ <i>Scomberomorus regalis</i> .
Cowfish and "shellfish".....	<i>Ostraciidae</i> (species).
Crappie.....	<i>Pomoxis sparoides</i> .
Crevalle.....	<i>Caranx</i> (species).
Croaker.....	<i>Micropogon undulatus</i> .

Drum, red and black.....	{ <i>Sciaenops ocellatus</i> . <i>Pogonias cromis</i> .
Eels.....	{ <i>Anguilla rostrata</i> . Other Apodes.
Flounders.....	Pleuronectidæ (species).
Gizzard shad.....	<i>Dorosoma cepedianum</i> .
Groupers.....	{ <i>Epinephelus</i> (species). <i>Mycteroperca</i> (species). <i>Garrupa nigrita</i> .
Grunts.....	Hæmulidæ (species).
Hickory shad.....	<i>Pomolobus mediocris</i> .
Hogfish.....	<i>Lachnolaimus maximus</i> .
Jewfish.....	<i>Promicrops guttatus</i> .
King whiting.....	<i>Menticirrhus</i> (species).
Ladyfish.....	<i>Albula vulpes</i> .
Leather jacket or "turbot".....	<i>Balistes carolinensis</i> .
Menhaden.....	<i>Brevortia tyrannus</i> .
Moonfish.....	<i>Vomer setipinnis</i> .
Mullet.....	{ <i>Mugil cephalus</i> . <i>Mugil curema</i> .
Parrotfish.....	Scaridæ (species).
Perch, white.....	<i>Morone americana</i> .
Perch, yellow.....	<i>Perca flavescens</i> .
Permit.....	<i>Trachinotus goodii</i> .
Pigfish.....	<i>Orthopristis chrysopterus</i> .
Pike or pickerel.....	<i>Esox</i> (species).
Pinfish or sailor's choice.....	{ <i>Lagodon rhomboides</i> . Other species.
Pompano.....	{ <i>Trachinotus carolinus</i> . <i>Trachinotus</i> (other species). (See also Permit.)
Porgies (Gulf).....	{ <i>Calamus</i> (species). <i>Pagrus</i> (species).
Porkfish.....	<i>Anisotremus virginicus</i> .
Scup.....	<i>Stenotomus</i> (species).
Sea bass.....	<i>Centropristes striatus</i> .
Sea gar or needlefish.....	{ <i>Tylosurus</i> (species). <i>Ablennes</i> (species).
Sergeantfish or snook.....	<i>Centropomus undecimalis</i> .
Shad.....	<i>Alosa sapidissima</i> .
Sharks.....	All Selachii except Batoidei.
Sheepshead.....	<i>Archosargus probatocephalus</i> .
Skates.....	Batoidei (species).
Snapper, mangrove.....	<i>Lutianus griseus</i> .
Snapper, mutton.....	<i>Lutianus analis</i> .
Snapper, red.....	<i>Lutianus blackfordi</i> .
Spanish mackerel.....	<i>Scomberomorus maculatus</i> .
Spot.....	<i>Leiostomus xanthurus</i> .
Squeteagues or "sea trout".....	{ <i>Cynoscion regalis</i> . <i>Cynoscion nothus</i> . <i>Cynoscion nebulosus</i> .
Striped bass.....	<i>Morone saxatilis</i> .
Sturgeon.....	<i>Acipenser sturio</i> .
Suckers.....	Castostomidæ (species).
Sunfish.....	Centrarchidæ (species).
Tautog.....	<i>Tautoga onitis</i> .
Tilefish.....	<i>Lopholatilus chamaeleonticeps</i> .
Yellowtail or "silver perch".....	<i>Bairdiella chrysura</i> .

GENERAL STATISTICS

The number of persons engaged in the fisheries of the South Atlantic States in 1918 was 15,046, of whom 1,964 were on vessels fishing, 91 on vessels transporting fishery products, 8,604 in shore fisheries, and 4,387 shoremen in the wholesale fishery trade, oyster canneries, fertilizer factories, and other industries connected with

the fisheries. Of the total, 8,036 are credited to North Carolina, 2,000 to South Carolina, 1,680 to Georgia, and 3,330 to the east coast of Florida.

Compared with the returns for 1902, there has been a decrease in the number of persons employed in North Carolina of 6,719, or 45.54 per cent; in South Carolina, a decrease of 1,713, or 46.14 per cent; in Georgia, a decrease of 606, or 26.51 per cent, and in Florida, an increase of 632 persons, or 23.42 per cent. The total decrease for the entire region amounts to 8,406, or 35.84 per cent.

The capital invested in the fisheries of this region amounted to \$7,423,971, distributed as follows: North Carolina, \$4,222,043; South Carolina, \$221,251; Georgia, \$769,998; and the east coast of Florida, \$2,210,679. The investment included 261 fishing and transporting vessels, valued at \$1,855,588 and having a net tonnage of 5,597 tons and outfits valued at \$565,858; 5,632 boats, valued at \$910,218; fishing apparatus used by vessels and boats, valued at \$957,239; shore and accessory property to the value of \$2,731,918; and cash capital to the amount of \$403,150.

Compared with 1902, there has been an increase in the investment in North Carolina amounting to \$2,248,602, or 113.94 per cent; in South Carolina, a decrease of \$99,472, or 31.01 per cent; in Georgia, an increase of \$427,848, or 125.04 per cent, and on the east coast of Florida, an increase of \$1,855,844, or 523.01 per cent, representing a total increase for the region of \$4,432,822, or 148.19 per cent.

The principal forms of fishing apparatus arranged in order of their value were: 3,779 pound nets, valued at \$355,439; 15,399 gill nets, valued at \$233,883; 91 purse seines, valued at \$219,027; 582 haul seines, valued at \$102,193; and 371 otter trawls, valued at \$22,055. Other apparatus employed included fyke nets, dredges, lines, cast nets, stop nets, eel pots, tongs, grabs, rakes, spears, etc., to the value of \$24,642. The use of the otter trawl introduced in the shrimp fishery at Fernandina, Fla., about 1915, represents the most important change in fishing apparatus since 1902.

The products of the fisheries amounted to 332,614,123 pounds, having a value to the fishermen of \$5,348,616. The yield of the various States was as follows: North Carolina, 210,501,750 pounds, valued at \$2,978,708; South Carolina, 3,746,932 pounds, valued at \$207,690; Georgia, 37,153,953 pounds, valued at \$416,043; and east coast of Florida, 81,211,488 pounds, valued at \$1,746,175.

The more important species taken in these States were: Alewives fresh and salted, taken mostly in North Carolina, 15,185,585 pounds, valued at \$412,067; black bass, credited to North Carolina, 551,125 pounds, valued at \$63,137; bluefish, 892,045 pounds, valued at \$85,567; cero and kingfish, taken mostly in Florida, 2,483,647 pounds, valued at \$161,562; menhaden, 257,757,799 pounds, valued at \$1,605,117; mullet, fresh and salted, 11,757,318 pounds, valued at \$508,044; sea bass, 577,596 pounds, valued at \$50,592; shad, 2,888,644 pounds, valued at \$568,585; Spanish mackerel, credited mostly to Florida, 3,211,405 pounds, valued at \$232,355; spot, 1,692,775 pounds, valued at \$72,795; squeteagues or "sea trout," 5,105,249 pounds, valued at \$360,527; shrimp, 15,656,903 pounds, valued at \$470,346; and oysters, 5,871,376 pounds, or 838,768 bushels, valued at \$260,863.

Compared with the Bureau's returns for 1902, there has been an increase in the products of the fisheries of 226,168,051 pounds, or 212.47 per cent, in quantity and of \$2,508,983, or 88.35 per cent, in value. Compared with the census returns for 1908, the increase

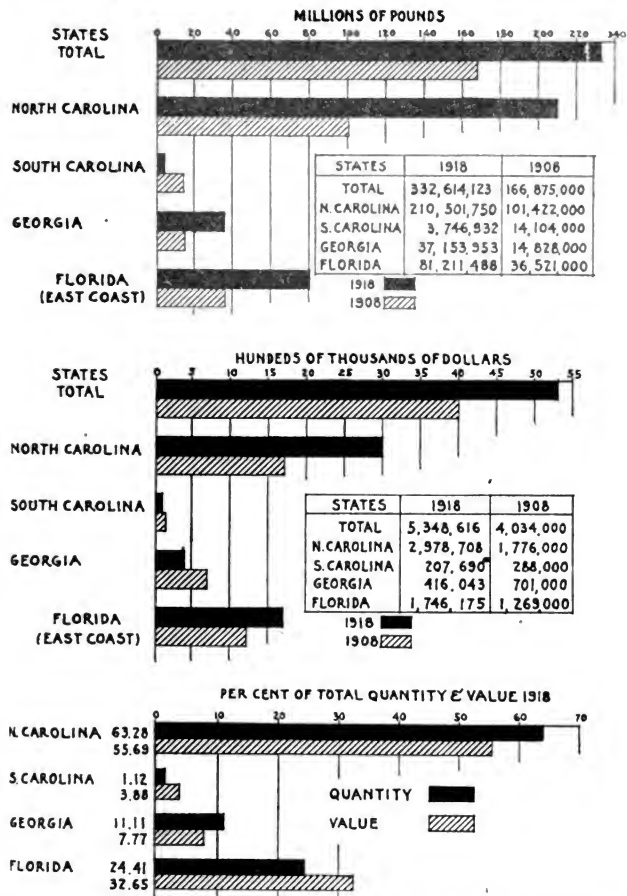


FIG. 7.—Top: Quantities of fish taken in the commercial fisheries of the South Atlantic States in 1918 compared with 1908. Center: Values of fish taken in the commercial fisheries of the South Atlantic States in 1918 compared with 1908. Bottom: Percentages of total quantity and value of fishery products for each of the South Atlantic States in 1918.

amounts to 165,739,123 pounds, or 99.31 per cent, in quantity and \$1,314,616, or 32.58 per cent, in value. The large increase in the catch for 1918 over that of previous years is due to the increase in the catch of menhaden, the 1902 catch amounting to 18,862,000 pounds, valued at \$31,420. The catch of other species in 1902

amounted to 87,584,072 pounds, valued at \$2,808,213, and in 1918 to 74,856,324 pounds, valued at \$3,743,499, a decrease of 14.53 per cent in quantity and an increase of 33.30 per cent in value. Compared with 1902 the increase in North Carolina amounted to 142,917,016 pounds, or 211.46 per cent, in quantity and \$1,239,047, or 71.22 per cent, in value; in Georgia, to 26,051,343 pounds, or 234.64 per cent, in quantity and \$56,962, or 15.86 per cent, in value; and on the east coast of Florida, to 61,627,223 pounds, or 314.67 per cent, in quantity and \$1,268,307, or 265.41 per cent, in value. In South Carolina there was a decrease in the quantity amounting to 4,427,531 pounds, or 54.16 per cent, and in value of \$55,333, or 21.03 per cent.

As an index of the trend of the fisheries of the South Atlantic States it is of interest to compare for various years from 1890 to 1918 the catch of certain staple species with the take of forms which have increased greatly in importance in recent years, species of which in the past there has been a comparative abundance but a lack of demand. For this purpose alewives, mullet, shad, squeteagues, and oysters have been selected as representative of staple varieties and cero (including kingfish), red and black drum, menhaden, Spanish mackerel, and shrimp, representing species for which the demand has greatly increased in recent years, resulting in much more intensive fishing operations. Lacking accurate data, for comparative purposes, as to the intensiveness with which these fisheries were prosecuted, it is difficult to draw definite conclusions regarding the present status of these fisheries, but the figures are nevertheless of interest. A study of the appended table reveals comparatively small fluctuations in the catch of alewives over the entire period. The fishery for mullet has more than doubled since 1890 but shows a reduction in the catch in 1918 as compared with 1902 and 1908. That the supply of shad is being depleted is indicated by the striking reduction in the catch in 1918 in comparison with that for other years. In comparison with 1908, the decrease amounts to 5,683,356 pounds, or 66.30 per cent. The fluctuation in the catch of squeteagues is not so marked, and in the absence of accurate information as to the intensiveness of fishing operations for the various years, the status of this fishery is largely conjectural. As on other parts of the coast, there has been a striking decline in the take of oysters.

With greater development of the fisheries and inability to supply the demand for staple varieties, the growth of other fisheries has been quite striking as indicated by the statistics for cero and kingfish, red and black drum, Spanish mackerel, and shrimp. On the Atlantic seaboard, the demand for red drum or "channel bass," as it is often called, has never been as great as on the Gulf and difficulty has been experienced in marketing it, particularly in the more northern part of its range. The increased catch of menhaden for conversion into oil and scrap is also of interest.

PRODUCTS, IN POUNDS, OF CERTAIN FISHERIES OF THE SOUTH ATLANTIC STATES, VARIOUS YEARS, 1890 TO 1918.

Year.	Alewives.	Mullet.	Shad.	Squeteague or sea trout.	Oysters.
1890.....	16,543,783	5,573,623	9,385,354	2,368,067	8,344,805
1897.....	15,856,350	5,934,942	11,268,343	3,741,274	11,285,268
1902.....	11,601,172	14,310,808	9,849,338	4,848,269	22,719,074
1908.....	12,180,000	14,501,800	8,572,000	8,615,000	30,549,000
1918.....	15,185,585	11,757,318	2,888,644	5,105,249	5,871,376

PRODUCTS, IN POUNDS, OF CERTAIN FISHERIES OF THE SOUTH ATLANTIC STATES, VARIOUS YEARS, 1890 TO 1918—Continued.

Year.	Cero and kingfish.	Drum, red and black.	Menhaden.	Spanish mackerel.	Shrimp.
1890.		692,003	12,410,400		744,025
1897.	358,070	772,032	11,310,000	362,390	627,221
1902.	77,170	583,394	18,862,000	1,013,172	3,810,641
1908.		1,421,000	57,412,000	1,685,000	5,697,000
1918.	2,483,647	1,007,311	257,757,799	3,211,405	15,656,903

As indicative of the trend of important fisheries common to the South Atlantic and Gulf coasts the following table is of interest. In view of the present high degree of development of the fisheries in these sections, it is becoming increasingly important that frequent statistical inventories be made to supply information as to whether these fisheries are being endangered and as to the needs for restrictive measures to safeguard the harvests of the future.

PRODUCTS, IN POUNDS, OF CERTAIN FISHERIES OF THE SOUTH ATLANTIC AND GULF STATES, VARIOUS YEARS, 1890 TO 1918.

Year.	Mullet.	Spanish mackerel.	Squeteague or sea trout.	Shrimp.	Oysters.
1890.	20,758,740	700,459	5,327,500	8,195,375	28,931,908
1897.	21,286,828	1,089,066	6,835,377	7,418,246	27,942,406
1902.	41,544,130	2,597,063	9,637,316	16,177,551	56,835,009
1908.	33,354,800	3,171,000	12,705,000	18,258,001	74,932,000
1918.	40,398,682	6,706,250	10,065,987	42,799,902	29,625,841

The following tables contain statistics of the number of persons employed, the amount of capital invested, the quantity and value of the products of the fisheries of the South Atlantic States in 1918, and comparative statistics of persons, investment, and products for various years from 1880 to 1918.

FISHERIES OF THE SOUTH ATLANTIC STATES, 1918.

Item.	North Carolina.		South Carolina.	
	Number.	Value.	Number.	Value.
PERSONS ENGAGED.				
On vessels fishing.	1,295		103	
On vessels transporting.	54		20	
In shore fisheries.	4,903		1,121	
Shoremen.	1,784		756	
Total.	8,036		2,000	
INVESTMENT.				
Vessels fishing:				
Steam.	15	\$807,315		
Tonnage.	1,791			
Outfit.		246,685		
Gasoline.	55	413,710	3	\$7,095
Tonnage.	1,258		74	
Outfit.		166,360		2,075
Sail.	48	28,700	33	20,995
Tonnage.	388		357	
Outfit.		9,745		4,415
Vessels transporting:				
Gasoline.	25	24,600	7	11,000
Tonnage.	197		74	
Outfit.		13,775		1,350
Sail.	12	9,700		
Tonnage.	92			
Outfit.		4,450		

FISHERIES OF THE SOUTH ATLANTIC STATES, 1918—Continued.

Item.	North Carolina.		South Carolina.	
	Number.	Value.	Number.	Value.
INVESTMENT—continued.				
Boats:				
Sail, row, etc.	1,727	\$38,053	639	\$15,810
Power.	1,357	269,720	81	20,000
Apparatus, vessel fisheries:				
Purse seines.	57	156,727		
Gill nets.	13	800		
Lines.		50		100
Otter trawls.	2	100		
Dredges.	86	2,655		
Tongs and grabs.	22	100	165	\$27
Apparatus, shore fisheries:				
Purse seines.	3	1,600		
Haul seines.	440	41,833	25	2,550
Gill nets.	14,299	108,878	233	16,525
Pound nets.	3,779	355,479		
Fyke nets.	591	6,230		
Cast nets.			71	155
Stop nets.	6	90	2	130
Lines.		333		515
Otter trawls.	27	960	2	80
Eel pots.	1,585	1,329		
Dredges.	550	2,648		
Tongs, grabs, and rakes.	1,008	2,046	549	1,482
Spears or gigs.	80	78	36	27
Crab traps and drags.	113	565		
Other apparatus.		375		27
Shore and accessory property.		1,347,644		95,775
Cash capital.		139,050		20,100
Total.		4,222,043		221,251
PRODUCTS.				
Alwivies:	Pounds.	Value.	Pounds.	Value.
Fresh.	8,739,944	\$238,624		
Salted.	5,743,876	162,595	9,500	\$175
Angefish.	8,975	349		
Black bass.	551,125	63,127		
Bluefish.	322,744	29,677	3,000	55
Bonito.	3,015	107		
Bowfin.	34,372	319		
Butterfish.	731,257	24,785	600	45
Carp.	153,169	5,619		
Catfish.	304,509	9,787	2,900	108
Cero and Kingfish.	211,781	13,947		
Crappie.	5,340	568		
Crevaille.	204	11	309	85
Croaker.	380,897	11,912	16,000	1,062
Drum, red and black.	99,546	3,246	6,000	283
Eels.	174,541	13,333		
Flounders.	91,121	7,022	16,200	1,001
Gizzard shad.	44,525	1,154		
Grunts.	15,000	1,150	130	10
Hickory shad.	158,443	13,388	20,500	2,000
King whiting.			40,125	4,707
Menhaden.	179,910,599	1,306,489		
Mullet:				
Fresh.	812,679	52,734	58,050	1,223
Salted.	315,350	38,341	142,700	14,095
Perch:				
White.	617,088	31,150		
Yellow.	223,813	10,147		
Pigfish:				
Fresh.	264,272	12,675		
Salted.	3,125	63		
Pike.	20,552	1,898		
Pinfish or sailor's choice.	50,179	1,225	2,330	145
Pompano.	8,685	994		
Porgies.			2,000	130
Sea bass.	111,650	10,928	132,000	13,300
Shad.	1,657,036	376,095	167,462	29,083
Sharks.			20,000	175
Sheepshead.	26,223	1,839	2,100	210
Skates.			2,000	15
Spanish mackerel.	149,440	14,270		
Spot:				
Fresh.	1,193,270	52,531	37,000	2,154
Salted.	42,825	3,768	25,550	2,685
Squeteagues or "sea trout".				
Fresh.	3,361,246	209,483	59,150	4,846
Salted.	80	10		
Striped bass.	286,528	46,030		
Sturgeon.	6,916	974	117,225	21,133
Sturgeon caviar.	671	1,497	665	888

FISHERIES OF THE SOUTH ATLANTIC STATES, 1918—Continued.

Item.	North Carolina.		South Carolina.	
	Pounds.	Value.	Pounds.	Value.
PRODUCTS—continued.				
Shad.....	16,464	\$680		
Shadfish.....	123,980	1,202	3,000	\$180
Tautog.....	150	9		
Yellow tail or "silver perch".....	31,288	1,379	900	37
Shrimp.....	940,120	23,485	55,400	6,220
Crabs.....				
Hard.....	145,605	1,983	18,000	400
Soft.....	233,705	23,821	300	75
Clams, hard.....	197,576	40,598	800	200
Oysters, market:				
Public.....	1,500,534	67,380	2,631,755	83,892
Private.....	18,200	2,900	152,075	12,650
Scallops.....	422,832	31,618		
Terrapin.....	210	92	1,275	545
Turtles.....	8,400	77		
Beak hides.....	19,125	2,808		
Other aquatic hides.....	1,050	157		
Total.....	210,501,750	2,978,708	3,746,932	207,600

Item.	Georgia.		Florida (east coast).		Total.	
	Number.	Value.	Number.	Value.	Number.	Value.
PERSONS ENGAGED.						
On vessels fishing.....	186		380		1,964	
On vessels transporting.....	2		15		91	
In shore fisheries.....	476		2,104		8,604	
Boysmen.....	1,016		831		4,387	
Total.....	1,680		3,330		15,046	
INVESTMENT.						
Vessels fishing:						
Steam.....					15	\$807,315
Tonnage.....					1,791	
Outfit.....						246,685
Gasoline.....	27	\$119,848	23	\$377,600	108	918,163
Tonnage.....	499		725		2,556	
Outfit.....		41,416		71,287		281,138
Sail.....	5	2,315			86	52,010
Tonnage.....	44				789	
Outfit.....		325				14,485
Vessels transporting:						
Gasoline.....	1	500	7	32,300	40	68,400
Tonnage.....	9		89		369	
Outfit.....		125		3,850		19,100
Sail.....					12	9,700
Tonnage.....					92	
Outfit.....						4,450
Boats:						
Sail, row, etc.....	313	8,805	607	20,160	3,286	82,848
Power.....	99	77,400	839	459,650	2,346	827,370
Apparatus, vessel fisheries:						
Purse seines.....	4	4,800	25	52,900	86	214,427
Gill nets.....					13	800
Lines.....		105				255
Otter trawls, a.....	12	705			14	805
Dredges.....	6	300			92	2,955
Tongs and grabs.....	42	160			229	787
Apparatus, shore fisheries:						
Purse seines.....			2	3,000	5	4,600
Haul seines.....	2	80	115	58,050	582	102,193
Gill nets.....	139	5,955	715	101,725	15,386	235,083
Pound nets.....					3,779	353,439
Fyke nets.....					591	6,230
Cast nets.....	1	3	16	80	88	238
Stop nets.....					8	220
Lines.....		13		2,905		3,826
Otter trawls.....	73	3,700	255	16,500	357	21,250
Eel pots.....					1,585	1,329
Dredges.....					550	2,648
Tongs, grabs, and rakes.....	400	1,264	37	224	1,994	5,016
Spear or gill.....			12	12	128	117
Crab traps and drags.....			20	60	133	615
Other apparatus.....				5		406
Shore and accessory property.....		429,779		858,720		2,731,918
Cash capital.....		72,400		151,600		403,150
Total.....		769,998		2,210,679		7,423,971

FISHERIES OF THE SOUTH ATLANTIC STATES—Continued.

Item.	Georgia.		Florida (east coast).		Total.	
PRODUCTS.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Atewives:						
Fresh			692,265	\$10,373	9,441,709	\$249,472
Salted					5,743,876	162,595
Amberfish			11,686	390	11,686	390
Angelfish			2,915	91	11,890	431
Barracuda			2,915	97	2,915	97
Black bass					551,125	63,137
Bluefish	5,000	\$900	561,301	54,715	802,045	85,567
Blue runner or hardtail			50,750	1,542	50,750	1,542
Bonito			8,141	258	11,156	365
Bowfin					34,372	319
Butterfish			4,200	170	736,057	25,000
Carp					153,169	5,618
Catfish	2,675	265	13,900	278	323,984	10,434
Cero and Kingfish	74	7	2,271,792	147,608	2,483,647	161,562
Cowfish and "shellfish"			50	2	50	2
Crappie					5,340	568
Crevalle			321,030	9,833	321,534	9,906
Croaker	5,900	235	124,278	3,447	532,985	16,676
Drum, red and black	1,674	112	900,091	24,638	1,007,311	28,281
Eels					174,541	13,333
Flounders	10,800	650	13,490	737	131,611	9,470
Gizzard shad					44,525	1,154
Groupers	27,758	1,019	74,783	3,622	102,541	4,643
Grunts	512	26	115,679	3,620	129,291	4,811
Hickory shad	13,007	2,035			191,930	17,423
Hogfish			250	11	250	11
Jewfish			12,487	365	12,487	365
King whiting	27,230	1,468	297,008	15,604	364,363	21,778
Ladyfish			1,280	13	1,280	13
Leatherjacket or "turbot"			370	13	370	13
Menhaden	29,484,600	88,453	48,362,600	210,175	257,757,799	1,605,117
Moonfish			7,970	245	7,970	245
Mullet:						
Fresh	10,650	693	10,417,889	397,147	11,299,268	454,797
Salted					458,050	53,243
Parrotfish			3,500	70	3,500	70
Perch:						
White					617,088	31,130
Yellow					223,813	10,161
Permit			7,290	244	7,290	244
Pigfish:						
Fresh			14,762	451	279,034	13,120
Salted					3,125	6
Pike					20,552	1,898
Pinfish or sailor's choice			442,535	13,033	495,014	14,000
Pompano			133,419	19,889	142,104	20,888
Porgies			5,950	328	7,950	438
Porkfish			1,710	57	1,710	57
Scup	12,000	900			12,000	900
Sea bass	292,615	23,765	41,331	2,699	577,596	50,501
Sea gar or needlefish			100	5	100	5
Sergeantfish or snook			314,774	8,629	314,774	8,629
Shad	100,540	26,960	963,606	135,844	2,888,644	568,594
Sharks	1,289	30	63,775	526	85,064	738
Sheepshead	400	25	104,303	4,115	133,026	6,191
Skates					2,000	1
Snapper:						
Mangrove			23,186	975	23,186	975
Mutton			241,078	7,399	241,078	7,399
Red	112,349	7,810	20,200	2,000	132,549	9,810
Spanish mackerel			3,061,965	218,085	3,211,405	232,365
Spot:						
Fresh	1,100	59	393,030	11,998	1,624,400	66,940
Salted					68,375	5,800
Squeteagues or "sea trout":						
Fresh	39,550	4,097	1,645,223	142,091	5,108,169	360,510
Salted					80	1
Striped bass	125	10			286,653	46,000
Sturgeon	39,150	4,700			163,291	26,800
Sturgeon caviar					1,336	2,300
Suckers					16,464	61
Sunfish					126,980	1,300
Tautog					150	1
Tilefish	35,000	2,400			35,000	2,400
Yellowtail or "silver perch"	2,000	100	43,970	1,279	78,148	2,700
Shrimp	5,793,465	173,990	8,867,918	266,651	15,656,903	470,300
Crabs:						
Hard	8,455	504	52,000	1,800	224,060	4,600
Soft					234,005	23,800
Sea crawfish or spiny lobster			23,503	1,174	23,503	1,174

* 672,180 in number.

* 702,015 in number.

FISHERIES OF THE SOUTH ATLANTIC STATES—Continued.

Item.	Georgia.		Florida (east coast).		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
PRODUCTS—continued.						
Clams, hard.....	120	\$75	2,400	\$600	¹ 200,806	\$47,473
Cook meat.....			7,000	700	7,000	700
Oysters, market:						
Public.....	481,530	30,884	313,425	15,134	² 4,927,244	197,290
Private.....	628,292	43,029	145,565	4,994	³ 944,132	63,573
Scallops.....					⁴ 422,832	31,618
Octopus.....	2,731	268			2,731	268
Terrapin.....	2,112	454			3,597	1,091
Turtles.....	11,250	100	6,850	402	26,500	579
Shark hides.....					19,125	2,868
Other aquatic hides.....					1,050	157
Total.....	37,153,953	416,043	81,211,488	1,746,175	332,614,123	5,348,616

¹ 25,112 bushels.² 703,892 bushels.³ 134,876 bushels.⁴ 70,472 bushels.EXTENT OF FISHERIES OF SOUTH ATLANTIC STATES, VARIOUS YEARS, 1880 TO 1918.¹

State.	1880	1887	1888	1889
PERSONS ENGAGED.				
North Carolina.....	5,274	7,352	7,704	8,655
South Carolina.....	1,005	1,280	1,346	2,642
Georgia.....	899	627	638	1,497
Florida (east coast).....	368	(²)	851	1,244
Total.....	7,546	(²)	10,539	14,038
INVESTMENT.				
North Carolina.....	\$506,561	\$766,881	\$801,474	\$968,600
South Carolina.....	66,275	92,930	97,189	107,205
Georgia.....	78,770	61,806	65,556	120,975
Florida (east coast).....	43,554	(²)	109,670	128,434
Total.....	695,160	(²)	1,073,889	1,325,214
PRODUCTS.				
Pounds:				
North Carolina.....	32,249,488	45,124,956	43,022,855	45,545,643
South Carolina.....	6,143,250	4,075,537	4,180,847	4,879,125
Georgia.....	2,272,500	1,882,790	1,957,749	2,643,533
Florida (east coast).....	2,286,750	(²)	(²)	5,982,375
Total.....	42,951,988	(²)	(²)	59,050,676
Value:				
North Carolina.....	\$845,695	\$772,957	\$776,439	\$950,427
South Carolina.....	212,482	157,688	163,657	200,381
Georgia.....	119,993	80,745	82,910	105,727
Florida (east coast).....	78,408	(²)	173,886	199,043
Total.....	1,256,578	(²)	1,196,892	1,455,578

¹ Statistics for 1908 are from data published by the Bureau of the Census.² Statistics not available.

**EXTENT OF FISHERIES OF SOUTH ATLANTIC STATES, VARIOUS YEARS, 1880 TO 1918—
Continued.**

State.	1880	1897	1902	1908	1918
PERSONS ENGAGED.					
North Carolina.....	10,274	12,045	14,755	9,681	8,068
South Carolina.....	2,701	2,139	3,713	2,559	2,000
Georgia.....	1,622	1,869	2,286	2,525	1,688
Florida (east coast).....	1,404	1,132	2,698	3,196	3,330
Total.....	16,001	17,185	23,452	17,961	15,086
INVESTMENT.					
North Carolina.....	\$1,243,988	\$1,218,459	\$1,973,441	\$1,270,000	\$4,222,043
South Carolina.....	127,762	174,354	320,723	114,000	221,251
Georgia.....	174,431	284,864	342,150	409,000	769,998
Florida (east coast).....	142,105	151,155	354,835	531,000	2,210,579
Total.....	1,688,286	1,828,832	2,991,149	2,324,000	7,423,971
PRODUCTS.					
Pounds:					
North Carolina.....	51,769,142	64,234,257	67,584,734	101,422,000	210,501,750
South Carolina.....	4,944,840	5,280,446	8,174,463	14,104,000	3,746,982
Georgia.....	2,964,117	4,993,160	11,102,610	11,828,000	37,133,939
Florida (east coast).....	7,463,531	5,882,662	19,584,265	36,521,000	81,211,488
Total.....	67,201,630	80,390,465	106,446,072	166,875,000	332,614,157
Value:					
North Carolina.....	\$1,027,669	\$1,316,017	\$1,739,661	\$1,776,000	\$2,978,798
South Carolina.....	202,692	210,456	263,023	288,000	207,690
Georgia.....	123,563	170,605	359,081	701,000	416,043
Florida (east coast).....	219,870	136,077	477,868	1,269,000	1,746,175
Total.....	1,573,794	1,833,155	2,839,633	4,034,000	5,348,616

~ 1 Exclusive of persons and investment in canneries, packing houses, and other establishments.

OYSTER INDUSTRY OF SOUTH ATLANTIC STATES, VARIOUS YEARS, 1880 TO 1918.¹

Year.	North Carolina.		South Carolina.		Georgia.		Florida (east coast).		Total.	
	<i>Bushels.</i>	<i>Value.</i>	<i>Bushels.</i>	<i>Value.</i>	<i>Bushels.</i>	<i>Value.</i>	<i>Bushels.</i>	<i>Value.</i>	<i>Bushels.</i>	<i>Value.</i>
1880....	170,000	\$60,000	50,000	\$20,000	70,000	\$35,000	20,000	\$5,000	310,000	\$120,000
1887....	212,980	48,353	37,725	18,581	110,085	26,950	(²)	(²)	(²)	(²)
1888....	204,703	46,129	40,242	19,146	120,600	29,370	57,750	12,950	423,295	107,596
1889....	1,001,620	194,272	43,620	19,890	163,200	26,684	62,356	11,123	1,270,796	251,969
1890....	807,260	175,567	63,150	23,204	224,355	40,520	97,350	14,850	1,192,115	254,141
1895....	(²)	(²)	(²)	(²)	(²)	(²)	99,464	15,415	(²)	(²)
1897....	858,818	241,099	214,900	45,360	486,634	86,709	51,823	11,766	1,612,181	384,994
1902....	1,022,813	268,363	689,700	118,460	1,224,000	220,467	309,069	37,188	3,245,582	644,478
1908....	812,500	236,100	1,563,000	137,000	1,459,000	338,600	529,000	108,000	4,363,500	820,300
1910....	332,257	63,405	710,124	94,677	505,157	170,812	153,460	35,290	1,700,998	364,184
1918....	216,962	70,280	397,690	96,542	158,516	73,913	65,570	20,128	838,738	260,863

¹ Statistics for 1908 are from data published by the Bureau of the Census.

² Statistics not available.

FISHERIES OF NORTH CAROLINA.

The fisheries of North Carolina were more extensive than those of South Carolina, Georgia, and eastern coast of Florida combined in persons engaged, investment, and quantity and value of the products. In 1918 the number of persons employed in the coastal fisheries of this State was 8,036, of whom 1,295 were on vessels fishing, 54 on transporting vessels, 4,903 in the shore or boat fisheries, and 1,784 on shore in the wholesale establishments, canneries, and other fishery industries.

The investment in the fisheries of \$4,222,043 includes 118 fishing vessels, valued at \$1,249,725, with a net tonnage of 3,437 tons and outfits valued at \$422,790; 37 transporting vessels, valued at \$34,300, with a net tonnage of 289 tons and outfits valued at \$18,225; 3,084 power, sail, row, and other boats valued at \$307,773; fishing apparatus employed on vessels to the value of \$160,432; fishing apparatus employed in shore or boat fisheries to the value of \$522,104; shore and accessory property valued at \$1,347,644; and cash capital amounting to \$159,050.

The products amounted to 210,501,750 pounds, valued at \$2,978,708. The species of chief importance arranged in order of their value were: Menhaden, 179,910,599 pounds, valued at \$1,306,489; alewives, 14,483,820 pounds, valued at \$401,219, of which 5,743,876 pounds, valued at \$162,595, were salted; shad, 1,657,036 pounds, valued at \$376,696; squeteague or "sea trout," 3,361,326 pounds, valued at \$209,493; mullet, 1,128,029 pounds, valued at \$91,075, of which 315,350 pounds, valued at \$38,341, were salted; oysters, 1,518,734 pounds, or 216,962 bushels, valued at \$70,280; black bass, 551,125 pounds, valued at \$63,137; spot, 1,236,095 pounds, valued at \$56,299, of which 42,825 pounds, valued at \$3,768, were salted; hard clams, 197,576 pounds, or 24,697 bushels, valued at \$46,598; and striped bass, 286,528 pounds, valued at \$46,030.

Menhaden represents 85.46 per cent of the total quantity and 43.86 per cent of the total value of the products of the State in 1918. The products of the fisheries exclusive of menhaden for various years follow: 39,388,742 pounds, valued at \$1,011,498, in 1890; 52,924,257 pounds, valued at \$1,296,317, in 1897; 48,722,734 pounds, valued at \$1,708,241, in 1902; 44,010,000 pounds, valued at \$1,706,000, in 1908, and 30,591,151 pounds, valued at \$1,672,219, in 1918. From the foregoing it will be evident that the trend of production of food fishes is downward and should be a matter of some concern to the State. As indicative of the trend of certain of the important fisheries of the State, the following table gives the comparative production figures for various years:

PRODUCTS OF CERTAIN FISHERIES OF NORTH CAROLINA, VARIOUS YEARS, 1890 TO 1918.

Species.	1890	1897	1902	1908	1918
	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>
Alewives.....	16,481,063	15,790,437	11,172,975	10,928,000	14,483,820
Bluefish.....	1,345,194	1,606,175	977,142	1,256,000	322,744
Mullet.....	3,585,981	3,409,585	6,705,492	5,070,800	1,128,029
Shad.....	5,768,413	8,963,488	6,566,724	3,942,000	1,657,036
Squeteagues or "sea trout".....	1,885,677	3,000,254	3,781,456	4,635,000	3,361,326
Striped bass.....	568,341	845,123	1,175,400	510,000	286,528
	<i>Bushels.</i>	<i>Bushels.</i>	<i>Bushels.</i>	<i>Bushels.</i>	<i>Bushels.</i>
Clams.....	28,269	117,226	146,897	91,000	24,697
Oysters.....	807,260	858,818	1,022,813	812,500	216,962

An examination of this table reveals a very marked decline in the catch of bluefish, mullet, shad, striped bass, clams, and oysters, while the fisheries for alewives and squeteagues have fluctuated comparatively little. In 1918 the catch of bluefish amounted to only 25.69 per cent of that in 1908; of mullet, to only 22.25 per cent of the 1908 catch; of shad, to only 42.04 per cent of the catch in 1908, and 25.23 per cent of the catch in 1902; of striped bass, to

only 56.18 per cent of the 1908 catch and 24.38 per cent of the 1902 catch; of clams, to only 27.14 per cent of the 1908 catch and 16.81 per cent of the 1902 catch; and of oysters, to only 26.70 per cent of the 1908 catch and 21.21 per cent of the 1902 catch.

The principal factors affecting the abundance of shad in our Atlantic coast waters appear to be unsatisfactory spawning areas, due to pollution and artificial barriers restricting the movements of the fish in the rivers, and interference with the fish in their migrations to the spawning areas and while on these areas. It is conceivable that, unless these conditions are rectified, the consumer may have to depend on the Pacific coast for these fish at some not far distant date. In North Carolina, while pollution is believed to have been a less significant factor than in some of the other States, interference with the free movement of a sufficient body of the fish to the spawning areas and during the spawning period is considered to be an important factor affecting the supply of fish in the waters, which fish-cultural operations have been unable to wholly counteract. A study of the production figures for striped bass would indicate that the supply of this fish is being depleted. Difficulties in propagation, such as inability to procure ripe fish of both sexes at same time, handicap operations in this field. The decline in the catch of oysters would indicate how important it is for the State to give more serious consideration to the encouragement of oyster farming. In this connection the results of former investigations of the Bureau should prove of interest, notably a document by Dr. Caswell Grave.¹⁰

FISHERIES BY COUNTIES.

The statistics as to the number of persons employed, investment, and products of the fisheries of North Carolina in 1918 are given by counties in the appended table. It will be noted that of the catch of sea bass of 111,650 pounds, valued at \$10,928, 59,650 pounds, valued at \$5,763, are credited to Carteret County. The increase in the catch for this county is directly attributable in large part to the Bureau for its work in locating the small fishing grounds along this section of the coast and for encouragement given to the establishment of an important fishery. Difficulties in marketing the catch at satisfactory prices are reported to have retarded the fullest development of this fishery.

As a result of the Bureau's efforts to develop fisheries for sharks and other unutilized aquatic animals and to encourage the saving of the hides for tanning into leather and the extraction of the liver oil of sharks, etc., 20,175 pounds of the hides of sharks, porpoise, etc., valued at \$3,025, and 720 gallons of shark oil, valued at \$540, were saved in 1918.

¹⁰ Grave, Caswell: Investigations for the Promotion of the Oyster Industry of North America. Report U. S. Commission of Fish and Fisheries, 1903 (1905), p. 247-341, X pl.

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF NORTH CAROLINA IN 1918, BY COUNTIES.

Item.	Beaufort.		Bertie.		Bladen.		Brunswick.	
PERSONS ENGAGED.	Number.	Value.	Number.	Value.	Number.	Value.	Number.	Value.
On vessels fishing.....	12						59	
On vessels transporting.....	18							
In shore fisheries.....	236		22		45		301	
Shoresmen.....	167		13				147	
Total.....	433		35		45		597	
INVESTMENT.								
Vessels fishing:								
Gasoline.....							5	\$39,620
Tonnage.....							160	
Outfit.....								17,510
Sail.....	4	\$2,750						
Tonnage.....	30							
Outfit.....		950						
Vessels transporting:								
Gasoline.....	2	7,500						
Tonnage.....	15							
Outfit.....		5,000						
Sail.....	7	7,000						
Tonnage.....	50							
Outfit.....		3,500						
Boats:								
Sail, row, etc.....	74	6,195	1	\$5	23	\$270	151	2,210
Power.....	25	6,400	7	1,600			17	8,450
Apparatus, vessel fisheries:								
Purse seines.....							3	9,000
Otter trawls.....							2	100
Dredges.....	8	160						
Apparatus, shore fisheries:								
Haul seines.....	15	6,700					21	1,800
Gill nets.....	490	903			22	350	100	2,475
Pound nets.....	137	10,210	73	9,585				
Lines.....								1
Otter trawls.....							14	570
Dredges.....	21	549						
Tongs and rakes.....	2	6					160	268
Eel pots.....	250	325						
Other apparatus.....					1	12	6	90
Shore and accessory property.....		39,975		1,950				65,685
Cash capital.....		34,000						5,800
Total.....		132,123		13,140		632		153,579
PRODUCTS.								
Alewives:	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Fresh.....	326,465	\$6,760	211,845	\$4,209				
Salted.....			216,039	5,906				
Black bass.....	10,111	1,343						
Butterfish.....	70,009	4,128						
Catfish.....	44,008	1,113	982	20				
Cero and king fish.....							3,250	\$178
Croaker.....							1,500	43
Drum, red and black.....							1,500	73
Eels.....	39,161	1,076						
Flounders.....	5,800	348					8,800	433
Hickory shad.....	16,760	1,515	628	31				
Menhaden.....							9,300,000	33,325
Mullet:								
Fresh.....							28,700	2,180
Salted.....							213,900	25,450
Perch:								
White.....	6,630	613	2,261	121				
Yellow.....	40,485	2,778						
Pigfish, fresh.....							150	9
Pike.....	11,013	1,032						
Pompano.....	750	60						
Sea bass.....							1,000	70
Shad.....	80,057	14,270	5,396	1,182	4,077	\$1,165	2,050	425
Sheepshead.....							1,800	106
Spot:								
Fresh.....	5,148	255					11,250	587
Salted.....							36,700	3,370
Squeteagues, or "sea trout," fresh.....	314,892	10,734					8,600	604

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF NORTH CAROLINA IN 1918, BY COUNTIES—Continued.

Item.	Beaufort.		Bertie.		Bladen.		Brunswick.	
PRODUCTS—continued.	Number.	Value.	Number.	Value.	Number.	Value.	Number.	Value.
Striped bass.....	24,701	\$3,426	333	\$50			1,000	\$100
Suckers.....	4,800	124	131	8				
Tautog.....							150	9
Shrimp.....							370,000	11,000
Crabs:								
Hard.....							650	20
Soft.....							40	30
Turtles.....							500	13
Clams, hard.....							44,000	8,300
Oysters, market, public..	65,415	4,565					4,725	500
Total.....	1,066,608	54,140	437,585	11,527	4,077	\$1,165	10,040,265	86,865

Item.	Camden.		Carteret.		Chowan.		Columbus.	
PERSONS ENGAGED.	Number.	Value.	Number.	Value.	Number.	Value.	Number.	Value.
On vessels fishing.....			656					
On vessels transporting.....			35					
In shore fisheries.....	8		1,251		285		30	
Shoresmen.....			766		167			
Total.....	8		2,708		452		30	
INVESTMENT.								
Vessels fishing:								
Gasoline.....			49	\$356,150				
Tonnage.....			1,026					
Outfit.....				142,350				
Sail.....			26	17,500				
Tonnage.....			232					
Outfit.....				5,145				
Vessels transporting:								
Gasoline.....			22	16,600				
Tonnage.....			177					
Outfit.....				8,025				
Sail.....			4	2,450				
Tonnage.....			36					
Outfit.....				925				
Boats:								
Sail, row, etc.....	3	\$45	414	9,755	20	\$1,100	15	\$160
Power.....	5	835	461	112,875	101	26,410		
Apparatus, vessel fisheries:								
Purse seines.....			38	102,600				
Gill nets.....			13	800				
Lines.....				50				
Dredges.....			42	1,530				
Tongs.....			16	82				
Apparatus, shore fisheries:								
Haul seines.....			123	3,185				
Purse seines.....			1	1,000				
Gill nets.....	82	972	1,877	49,305	234	6,268	15	100
Pound nets.....			258	24,750	967	103,936		
Fyke nets.....	40	400						
Lines.....				230				
Otter trawls.....			13	390				
Dredges.....			492	1,525				
Tongs and rakes.....				432				
Eel pots.....			25	35				
Other apparatus.....			370	650				
Shore and accessory property.....				543,480		63,405		
Cash capital.....				74,000				
Total.....		2,252		1,475,828		201,089		310
PRODUCTS.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Alewives:								
Fresh.....			75,636	\$3,774		\$98,415		
Salted.....						87,768		
Angel fish.....			3,800	155				
Bluefish.....			261,055	23,545				
Bonito.....			3,015	107				
Butterfish.....			71,909	4,379				
Catfish.....	2,400	\$120			62,727	2,218		

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF NORTH CAROLINA IN 1918, BY COUNTIES—Continued.

Item.	Camden.		Carteret.		Chowan.		Columbus.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
PRODUCTS—continued.								
Cero and king fish			151, 871	\$10, 615				
Crevalle			204	11				
Croaker			323, 226	9, 863				
Drum, red and black			32, 165	1, 332				
Eels			1, 500	150	6, 890	\$549		
Flounders			8, 175	543				
Gizzard shad					34, 629	1, 036		
Hickory shad			23, 611	1, 449	58, 283	5, 832		
Menhaden			90, 232, 799	480, 212				
Mullet:								
Fresh			405, 855	19, 804				
Salted			22, 500	4, 000				
Perch, white	2, 300	\$230			72, 890	6, 333		
Pigfish, fresh			152, 669	4, 859				
Pike					294	28		
Pinfish, or sailor's choice			18, 380	238				
Pompano			2, 768	332				
Sea bass			59, 650	5, 763				
Shad	17, 800	4, 450	53, 994	13, 753	173, 472	34, 736	1, 575	\$450
Sheepshead			17, 039	988				
Spanish mackerel			115, 330	11, 372				
Spot, fresh			792, 565	30, 603				
Squeteagues, or "sea trout," fresh			1, 584, 096	122, 323				
Striped bass			995	133	17, 878	3, 577		
Sturgeon			540	27				
Suckers					8, 693	383		
Yellowtail			8, 108	226				
Shrimp			450, 120	9, 385				
Crabs:								
Hard			2, 000	150				
Soft			233, 665	23, 811				
Terrapin			60	57				
Turtles			7, 500	44				
Clams, hard			47, 176	8, 103				
Oysters, market, public			\$79, 977	31, 925				
Scallops			415, 572	30, 768				
Shark hides			19, 125	2, 868				
Other aquatic hides			1, 050	157				
Total	22, 500	4, 800	96, 479, 790	857, 827	8, 413, 269	240, 873	1, 575	450

Item.	Craven.		Currituck.		Dare.		Gates.	
	Number.	Value.	Number.	Value.	Number.	Value.	Number.	Value.
PERSONS ENGAGED.								
On vessels fishing					7			
In shore fisheries	66		427		762		30	
Shoresmen	4		20		13			
Total	70		447		782		30	
INVESTMENT.								
Vessels fishing:								
Sail					3	\$1, 300		
Tonnage					20			
Outfit						450		
Boats:								
Sail, row, etc.	47	\$385	57	\$700	86	3, 430	22	\$265
Power	20	3, 075	167	15, 530	287	41, 600	4	250
Apparatus, vessel fisheries:								
Dredges					6	30		
Tongs					6	18		
Apparatus, shore fisheries:								
Haul seines	8	850	183	16, 353	34	4, 525		
Purse seines					2	600		
Gill nets	463	1, 705	206	1, 879	7, 814	16, 131	74	248
Pound nets	25	750	56	10, 635	1, 581	143, 891	10	390
Fyke nets			455	4, 550			15	125
Lines						30		
Tongs and rakes					49	188		
Eel pots	20	25	1, 240	879				
Shore and accessory property		6, 265		4, 040		31, 488		
Cash capital				2, 750		2, 000		
Total		13, 255		50, 716		245, 681		1, 278

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF NORTH CAROLINA IN 1918, BY COUNTIES—Continued.

Item.	Craven.		Currituck.		Dare.		Gates.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
PRODUCTS.								
Alsewives:								
Fresh	22,800	\$725	142,068	\$4,252	777,636	\$36,700	73,688	\$1,170
Salted			133,083	2,140	128,355	4,547		
Angel fish	50	2						
Black bass			504,164	57,372	36,850	4,422		
Bluefish	700	42			46,944	4,674		
Bow fin			34,372	319				
Butterfish	30,000	1,200			437,473	12,345		
Carp			150,741	5,449				
Catfish	1,200	24	116,012	2,379	33,981	1,645	312	25
Cero and king fish			10,000	548	17,815	720		
Crappie							340	66
Croaker	3,050	77	13,600	354	16,538	726		
Drum, red and black					35,566	795		
Eels	500	40	112,581	10,268	8,000	680		
Flounders	600	35	4,948	330	19,567	977		
Gizzard shad			9,371	97				
Hickory shad	16,940	990			7,467	684		
Hullet, fresh	17,400	1,395						
Merch:								
White	3,100	282	412,040	16,206	71,659	2,874		
Yellow			150,555	6,187	23,886	958	312	25
Pigfish:								
Fresh	200	5			37,428	1,061		
Salted					3,125	63		
Pike			9,245	838				
Pinfish, or sailor's choice	3,000	50			22,700	337		
Pompano	75	8			1,012	57		
Shad	14,013	3,633	51,046	9,330	881,270	219,272	600	730
Sheepshead					834	60		
Spanish mackerel	250	200			27,973	2,091		
Spot:								
Fresh	19,300	989			49,082	2,232		
Salted					3,125	63		
Squeteagues, or "sea trout,"								
fresh	36,910	2,043	25,400	1,854	901,238	47,700		
striped bass	6,375	565	51,367	7,149	148,740	23,136		
Sturgeon					2,876	527		
Sturgeon caviar					661	1,487		
Humfish			123,980	1,202				
Crabs, hard					142,290	1,778		
Clams, hard					6,400	1,200		
Oysters, market, public					60,900	4,350		
Total	176,463	12,305	2,062,183	126,373	3,951,490	378,761	75,252	1,417

Item.	Halifax.		Hertford.		Hyde.		Martin.	
	Number.	Value.	Number.	Value.	Number.	Value.	Number.	Value.
PERSONS ENGAGED.								
On vessels fishing					2			
In shore fisheries	39		20		145		18	
Shoresmen			2					
Total	39		31		147		18	
INVESTMENT.								
Vessels fishing:								
Sail					1	\$400		
Tonnage					7			
Outfit						150		
Boats:								
Sail, row, etc	4	\$50	11	\$114	26	1,245	3	\$75
Power	19	1,170	4	975	55	11,295		
Apparatus, vessel fisheries,								
dredges					2	60		
Apparatus, shore fisheries:								
Haul seines			1	300	1	75	3	300
Gill nets			59	253	1,684	3,028		
Pound nets			37	2,450	233	22,423		
Dredges					2	40		
Tongs and rakes					78	310		
Other apparatus	47	275						
Shore and accessory property				125		1,665		
Total		1,495		4,117		40,693		575

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF NORTH CAROLINA IN 1918, BY COUNTIES—Continued.

Item.	Halifax.		Hertford.		Hyde.		Martin.	
PRODUCTS.								
Alewives:	<i>Pounds.</i>	<i>Value.</i>	<i>Pounds.</i>	<i>Value.</i>	<i>Pounds.</i>	<i>Value.</i>	<i>Pounds.</i>	<i>Value.</i>
Fresh.....			216, 875	\$5, 205	87, 706	\$3, 054	30, 000	\$1, 500
Salted.....							25, 000	1, 200
Angel fish.....					5, 125	183		
Bluefish.....					7, 495	848		
Butterfish.....					39, 626	978		
Catfish.....					2, 560	64	630	38
Cero and kingfish.....					3, 335	119		
Croaker.....					1, 993	43		
Drum, red and black.....					1, 350	14		
Eels.....					333	10		
Flounders.....					10, 781	394		
Hickory shad.....					15, 112	730		
Mullet, salted.....					650	169		
Perch:								
White.....			1, 584	96	3, 078	277	1, 000	80
Yellow.....					700	49		
Pigfish, fresh.....					3, 125	95		
Pompano.....					1, 280	92		
Shad.....			250	50	109, 827	18, 396		
Spanish mackerel.....					2, 987	242		
Spot, fresh.....					3, 325	150		
Squeteagues, or "sea trout," fresh.....					149, 964	4, 987		
Striped bass.....	6, 635	\$2, 770			10, 829	1, 509		
Oysters, market, public.....					38, 500	2, 200		
Total.....	6, 635	2, 770	218, 709	5, 351	499, 681	34, 603	56, 630	2, 818

Item.	New Hanover.		Onslow.		Pamlico.		Pasquotank and Perquimans.	
PERSONS ENGAGED.	<i>Number.</i>	<i>Value.</i>	<i>Number.</i>	<i>Value.</i>	<i>Number.</i>	<i>Value.</i>	<i>Number.</i>	<i>Value.</i>
On vessels fishing.....	513				46			
On vessels transporting.....					1			
In shore fisheries.....	238		318		97		47	
Shoresmen.....	322		35		64		11	
Total.....	1, 073		353		208		58	
INVESTMENT.								
Vessels fishing:								
Steam.....	15	\$807, 315						
Tonnage.....	1, 791							
Outfit.....		246, 683						
Gasoline.....	1	17, 940						
Tonnage.....	72							
Outfit.....		6, 500						
Sail.....					14	\$5, 750		
Tonnage.....					99			
Outfit.....						3, 050		
Vessels transporting:								
Gasoline.....					1	500		
Tonnage.....					5			
Outfit.....						750		
Sail.....			1	\$250				
Tonnage.....			6					
Outfit.....				25				
Boats:								
Sail, row, etc.....	157	2, 600	298	4, 935	55	1, 665	13	\$232
Power.....	15	3, 900	40	13, 775	39	7, 200	15	3, 220
Apparatus, vessel fisheries:								
Purse seines.....	16	45, 127						
Dredges.....					28	875		
Apparatus, shore fisheries:								
Haul seines.....	22	1, 180	18	1, 780				
Gill nets.....	77	3, 045	411	9, 850	35	1, 100	296	4, 060
Pound nets.....					70	3, 375	81	3, 610
Fyke nets.....							3	20
Lines.....		50		2				
Dredges.....			11	84	18	450		
Tongs and rakes.....	175	100	117	411	35	205		
Eel pots.....				65				
Other apparatus.....	25	23	14	14				
Shore and accessory property.....		560, 336		6, 505		6, 410		13, 000
Cash capital.....		25, 000		2, 000		2, 500		11, 000
Total.....		1, 719, 801		39, 696		34, 830		35, 145

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF NORTH CAROLINA IN 1918, BY COUNTIES—Continued.

Item.	New Hanover.		Onslow.		Pamlico.		Pasquotank and Perquimans.	
PRODUCTS.								
Alwolves:	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Fresh.....	15,000	\$1,200	177,507	\$6,250	3,750	\$125	150,000	\$3,000
Salted.....							39,000	200
Bluefish.....	500	62	5,400	435				
Butterfish.....			1,000	100	81,150	1,655		
Catfish.....	18,000	990						
Cero and king fish.....	2,000	249	22,250	1,495				
Crappie.....							300	30
Croaker.....			13,350	352	6,250	150		
Drum, red and black.....	8,000	480	3,000	22	11,665	110		
Eels.....			3,293	329				
Flounders.....	10,300	1,545	4,300	335				
Grunts.....	15,000	1,150						
Hickory shad.....	5,000	400						
Menhaden.....	80,377,800	792,952						
Mullet:								
Fresh.....	32,000	2,750	193,024	14,955	4,000	400		
Salted.....			47,000	5,232	5,800	800		
Perch, yellow.....							1,875	130
Pigfish, fresh.....	48,000	4,800	12,000	425				
Pinfish, or sailor's choice.....	6,000	600						
Pompano.....	2,300	345	500	100				
Sea bass.....	50,000	5,000	200	25				
Shad.....	38,600	11,275			20,250	3,750	134,600	26,920
Sheepshead.....	5,000	600	700	35	850	50		
Spanish mackerel.....	1,500	225	300	30	1,100	110		
Spot, fresh.....	31,000	2,350	77,050	3,865	1,250	50		
Squeteagues, or "sea trout":								
Fresh.....	13,500	1,765	103,896	9,258	198,950	5,445		
Salted.....					80	10		
Striped bass.....							9,250	1,800
Sturgeon.....	3,500	420						
Sturgeon caviar.....	10	10						
Yellowtail.....	3,000	180			170	5		
Shrimp.....	120,000	3,000						
Crabs, hard.....	665	35						
Terrapin.....			150	35				
Turtles.....	400	20						
Clams, hard.....	48,000	14,500	16,800	4,645				
Oysters, market:								
Public.....	10,500	600	24,150	3,750	402,367	18,490		
Private.....			14,700	2,500	3,500	400		
Scallops.....			7,290	850				
Total.....	80,865,575	\$47,503	727,830	\$5,043	741,132	31,550	335,025	\$2,340

Item.	Pender.		Tyrrell.		Washington.		Total.	
PERSONS ENGAGED.	Number.	Value.	Number.	Value.	Number.	Value.	Number.	Value.
On vessels fishing.....							1,295	
On vessels transporting.....							54	
In shore fisheries.....	264		89		156		4,903	
Shoresmen.....			20		27		1,784	
Total.....	264		115		183		8,036	
INVESTMENT.								
Vessels fishing:								
Steam.....							15	\$807,315
Tonnage.....							1,791	
Outfit.....								246,685
Gasoline.....							55	413,710
Tonnage.....							1,258	
Outfit.....								166,360
Sail.....							48	28,700
Tonnage.....							388	
Outfit.....								9,745
Vessels transporting:								
Gasoline.....							25	21,000
Tonnage.....							197	
Outfit.....								13,775
Sail.....							12	9,700
Tonnage.....							92	
Outfit.....								4,430

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF NORTH CAROLINA IN 1918, BY COUNTIES—Continued.

Item.	Pender.		Tyrrell.		Washington.		Total.	
INVESTMENT—Continued.								
Boats:	Number.	Value.	Number.	Value.	Number.	Value.	Number.	Value.
Sail, row, etc.	182	\$1,350	14	\$237	42	\$827	1,727	38,053
Power.	3	600	37	4,915	36	5,645	1,357	269,720
Apparatus, vessel fisheries:								
Purse seines.							57	156,727
Gill nets.							13	800
Lines.								50
Otter trawls.							2	100
Dredges.							86	2,655
Tongs.							22	100
Apparatus, shore fisheries:								
Haul seines.	8	985			3	3,400	440	41,533
Purse seines.							3	1,600
Gill nets.	34	830	164	1,680	174	4,676	14,299	108,878
Pound nets.			116	9,527	125	10,505	3,779	355,439
Fyke nets.			70	1,005	8	130	591	6,230
Lines.		20						333
Otter trawls.							27	960
Dredges.							550	2,648
Tongs and rakes.	210	125					1,008	2,046
Eel pots.							1,585	1,329
Other apparatus.	30	30			3	5	496	1,108
Shore and accessory property.		2,100		1,215				1,347,644
Cash capital.								159,050
Total.		6,041		18,579		25,188		4,222,043
PRODUCTS.								
Alewives:	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Fresh.		762,350		\$10,417	918,100	\$31,859	8,739,944	\$238,624
Salted.			1,151,383	27,623	820,991	33,021	5,743,876	162,595
Angel fish.							8,975	340
Black bass.							551,125	63,137
Bluefish.	650	\$51					322,744	29,677
Bonito.							3,015	107
Bowfin.							34,372	319
Butterfish.							731,257	24,785
Carp.					2,428	170	153,169	5,619
Catfish.	1,000	30	6,350	381	14,347	736	304,509	9,783
Cero and king fish.	300	23					211,781	13,947
Crappie.			4,700	470			5,340	568
Creville.							204	11
Croaker.	7,300	304					386,807	11,912
Drum, red and black.	6,300	420					99,546	3,246
Eels.					2,310	231	174,541	13,333
Flounders.	17,200	2,030			650	52	91,121	7,022
Gizzard shad.					525	21	44,525	1,154
Grunts.							15,000	1,150
Hickory shad.					14,642	1,757	158,444	13,388
Menhaden.							179,910,599	1,306,489
Mullet:								
Fresh.	131,700	11,250					812,679	52,734
Salted.	25,500	2,600					315,350	38,341
Perch:			8,806	838	31,650	3,110	617,088	31,150
White.							223,813	10,147
Yellow.								
Pigfish:								
Fresh.	10,700	821					264,272	12,675
Salted.							3,125	63
Pike.							20,552	1,898
Pinfish, or sailor's choice.							50,179	1,225
Pompano.							8,685	994
Sea bass.	800	70					111,650	10,928
Shad.	1,000	275	1,750	350	65,389	12,885	1,657,036	376,696
Sheepshead.							26,223	1,839
Spanish mackerel.							149,440	14,270
Spot:								
Fresh.	203,300	11,450					1,193,270	52,531
Salted.	3,000	335					42,825	3,768
Squeeteagues, or "sea trout":								
Fresh.	23,800	2,770					3,361,246	309,483
Salted.							80	10
Striped bass.			1,975	475	6,450	1,200	280,528	46,030
Sturgeon.							6,916	974
Sturgeon caviar.							671	1,497
Suckers.					2,750	165	16,464	680
Sunfish.							123,980	1,302

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF NORTH CAROLINA IN 1918, BY COUNTIES—Continued.

Item.	Pender.		Tyrrell.		Washington.		Total.	
	Number.	Value.	Number.	Value.	Number.	Value.	Number.	Value.
PRODUCTS—continued.								
Tautog.....							150	\$9
Yellowtail.....	20,000	\$965					31,278	1,379
Shrimp.....							940,120	23,483
Crabs:								
Hard.....							1 145,605	1,983
Soft.....							2 233,705	23,321
Terrapin.....							210	92
Turtles.....							8,400	77
Clams, hard.....	35,200	9,800					3 197,576	46,586
Oysters, market:								
Public.....	14,000	1,000					4 1,500,534	67,380
Private.....							5 18,200	2,900
Scallops.....							6 422,832	31,618
Shark hides.....							19,125	2,868
Other aquatic hides.....							1,050	157
Total.....	501,750	44,284	1,937,404	\$40,554	1,880,232	\$105,297	210,501,750	2,978,706

¹ 436,815 in number.
² 701,115 in number.

³ 24,697 bushels.
⁴ 214,362 bushels.

⁵ 2,600 bushels.
⁶ 70,472 bushels.

FISHERIES BY APPARATUS.

In the vessel fisheries of North Carolina, in which seven counties are represented, the forms of apparatus in use included purse seines, gill nets, lines, otter trawls, oyster dredges, and oyster tongs. The total yield from all forms of apparatus used on vessels was 179,072,191 pounds, valued at \$1,355,684. The catch with purse seines amounted to 178,101,814 pounds, valued at \$1,305,057, of which 177,868,599 pounds, valued at \$1,297,582, were menhaden. Other of the more important species taken in purse seines included mullet, 71,165 pounds, valued at \$2,630; croakers, 57,000 pounds, valued at \$1,765; and spots, 69,300 pounds, valued at \$1,385. Gill-net fishing yielded 83,300 pounds of fish, chiefly squeteague, croaker, kingfish, and bluefish, valued at \$6,265, and was prosecuted only from vessels operating in Carteret County. The catch of sea bass with lines was 47,500 pounds, valued at \$4,725. Shrimp were taken with otter trawls to the amount of 10,000 pounds, valued at \$300; oysters with dredges, 725,218 pounds, or 103,603 bushels, valued at \$34,912; and oysters with tongs, 104,359 pounds, or 14,908 bushels, valued at \$4,425.

In the shore or boat fisheries pound nets were the most productive form of apparatus, the catch amounting to 16,233,529 pounds, valued at \$683,292. The catch of alewives in pound nets amounted to 12,254,728 pounds, valued at \$301,577, or 75 per cent in quantity and 44 per cent in value of the total take by this form of gear. Other species of importance were squeteagues, shad, and butterfish. The catch with seines in the shore fisheries amounted to 6,028,340 pounds, valued at \$340,795, of which 5,605,300 pounds, valued at \$332,938, were taken in haul seines, the remainder being credited to purse seines. Among the more important species taken in haul seines were alewives, 1,589,037 pounds, valued at \$66,825; black bass, 533,364 pounds, valued at \$60,977; and mullet, 667,065 pounds, valued at \$53,559. The yield by gill nets, which was slightly less in quantity and exceeded in value that of seines, amounted to 5,995,917

pounds, valued at \$386,224. The principal varieties in the order of their value were shad, squeteague, mullet, and spot. The take with tongs, rakes, and hands totaled 767,262 pounds, valued at \$72,455, and with the exception of an incidental catch of scallops and terrapin was made up of oysters and clams. Various species were taken with scoop, dip, and bow nets, amounting to 364,383 pounds, valued at \$34,046; with lines, amounting to 386,010 pounds, valued at \$23,258; with fyke nets, amounting to 283,629 pounds, valued at \$11,375; and by stop nets, amounting to 10,840 pounds, valued at \$605. The catch with otter trawls, confined almost entirely to shrimp, was 592,580 pounds, valued at \$15,149; of scallops and oysters with dredges, 542,363 pounds, valued at \$36,761; of eels with pots, 161,046 pounds, valued at \$12,309; of soft crabs with drags, 38,660 pounds, valued at \$3,725, and of flounders with gigs, 25,000 pounds, valued at \$3,030. The total yield from all forms of apparatus used in the shore or boat fisheries was 31,429,559 pounds, valued at \$1,623,024. The products of the vessel and shore fisheries are shown separately by counties in the appended tables.

YIELD OF VESSEL FISHERIES OF NORTH CAROLINA IN 1918, BY COUNTIES, APPARATUS, AND SPECIES.

Apparatus and species.	Beaufort.		Brunswick.		Carteret.		Dare.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Purse seines:								
Bluefish.....					4,100	\$240		
Butterfish.....					1,750	70		
Croaker.....					57,000	1,765		
Drum.....					650	25		
Kingfish.....					250	10		
Menhaden.....			9,300,000	\$33,325	88,190,799	471,305		
Mullet.....					71,165	2,630		
Spanish mackerel.....					500	50		
Spots.....					69,300	1,385		
Squeteague.....					28,500	1,300		
Total.....			9,300,000	33,325	88,424,014	478,780		
Gill nets:								
Bluefish.....					4,800	415		
Butterfish.....					1,200	60		
Croaker.....					13,000	420		
Kingfish.....					8,700	502		
Pigfish.....					2,600	83		
Spots.....					1,000	30		
Squeteague.....					52,000	4,755		
Total.....					83,300	6,265		
Lines: Sea bass.....					47,500	4,725		
Otter trawls: Shrimp.....			10,000	300				
Dredges: Oysters, market, public.....	43,610	\$3,300			420,175	18,702	10,000	\$750
Tongs: Oysters, market, public.....					93,359	3,675	11,000	750
Grand total.....	43,610	3,300	9,310,000	33,625	89,068,348	512,147	21,000	1,500

YIELD OF VESSEL FISHERIES OF NORTH CAROLINA IN 1918, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

Apparatus and species.	Hyde.		New Hanover.		Pamlico.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Purse seines:								
Bluefish.....							4,100	\$240
Butterfish.....							1,750	70
Croaker.....							57,000	1,765
Drum.....							650	25
Kingfish.....							250	10
Menhaden.....			80,377,800	\$792,952			177,868,599	1,297,582
Mullet.....							71,165	2,630
Spanish mackerel.....							500	50
Spots.....							69,300	1,385
Squeteague.....							28,500	1,300
Total.....			80,377,800	792,952			178,101,814	1,305,057
Gill nets:								
Bluefish.....							4,800	415
Butterfish.....							1,200	60
Croaker.....							13,000	420
Kingfish.....							8,700	502
Pigfish.....							2,600	83
Spots.....							1,000	30
Squeteague.....							52,000	4,755
Total.....							83,300	6,265
Lines: Sea bass.....							47,500	4,725
Otter trawls: Shrimp.....							10,000	300
Dredges: Oysters, market, public.....	7,000	\$500			244,433	\$11,660	725,218	34,912
Tongs: Oysters, market, public.....							104,359	4,425
Grand total.....	7,000	500	80,377,800	792,952	244,433	11,660	179,072,191	1,355,684

YIELD OF SHORE FISHERIES OF NORTH CAROLINA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES.

BY SEINES.

Apparatus and species.	Beaufort.		Brunswick.		Carteret.		Currituck.		Craven.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Purse seines:										
Menhaden.....					300,000	\$1,500				
Shrimp.....					105,040	1,857				
Total.....					405,040	3,357				
Haul seines:										
Alewives—										
Fresh.....	117,365	\$2,970					86,653	\$1,835	22,600	\$715
Salted.....							121,000	1,694		
Black bass.....	10,111	1,343					490,089	55,654		
Bluefish.....					7,400	\$632			700	42
Bowfin.....							25,979	242		
Butterfish.....					2,850	117				
Carp.....							123,472	4,631		
Catfish.....	37,608	953					72,661	1,476		
Croaker.....					36,325	1,093	13,600	354	2,700	60
Drum.....					19,265	950				
Eels.....	1,512	45								
Flounders.....					825	57	1,600	80	250	16
Gizzard shad.....							9,371	97		
Hickory shad.....	14,060	1,272							5,000	250
Kingfish.....					38,700	2,767	10,960	548		
Mullet—										
Fresh.....			21,200	\$1,700	267,465	13,009				
Salted.....			163,900	19,450						
Perch, white.....	3,845	356					303,514	11,927	1,400	112
Perch, yellow.....	38,728	2,655					101,753	3,986		
Pigfish.....					13,419	333			200	5
Pike.....	11,013	1,032					4,467	409		
Pinfish.....					5,000	88			3,000	50
Pompano.....					790	95			50	6
Shad.....	26,600	4,787					24,000	4,000	2,000	535
Sheepshead.....					6,325	355				

YIELD OF SHORE FISHERIES OF NORTH CAROLINA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY SEINES—Continued.

Apparatus and species.	Beaufort.		Brunswick.		Carteret.		Currituck.		Craven.	
Haul seines—Con.										
Spanish mackerel	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Spot—										
Fresh	5,148	\$255	4,600	\$360	181,870	6,835			14,500	\$780
Salted			21,700	2,170						
Squeteague	164,283	5,822	100	10	52,250	3,427	25,400	\$1,854	16,000	1,160
Striped bass	5,894	793					15,111	1,533	5,500	440
Suckers	4,890	124								
Sunfish							104,422	1,026		
Yellowtail					1,500	42				
Crabs, soft					90,009	9,020				
Shrimp					117,000	3,254				
Turtles					2,000	11				
Total	461,057	22,407	211,500	23,690	847,398	42,530	1,534,052	91,346	73,960	4,171
Total, by seines	461,057	22,407	211,500	23,690	1,252,438	45,887	1,534,052	91,346	73,960	4,171

Apparatus and species.	Dare.		Hertford.		Hyde.		Martin.		Onslow.	
Purse seines: Striped bass	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
	18,000	\$1,500								
Haul seines:										
Alewives—										
Fresh			54,219	\$1,301			30,000	\$1,500		
Salted							25,000	1,200		
Black bass	33,164	\$3,980								
Bluefish	31,944	3,474			835	\$100			2,000	\$175
Butterfish									1,000	100
Catfish	900	14					620	38		
Croaker	11,151	540							4,300	122
Drum	19,066	585							3,000	22
Flounders									300	25
Kingfish	6,000	300							4,000	275
Mullet										
Fresh									36,000	2,400
Salted									35,500	3,970
Perch, white	41,958	1,679	772	48			1,000	80		
Perch, yellow	13,986	559								
Pigfish	22,428	1,061			375	15			3,000	75
Pinfish	22,049	322								
Pompano	808	45							500	100
Shad			125	25						
Sheepshead	120	10							400	20
Spanish mackerel	5,100	280							300	30
Spot—Fresh	33,453	1,620			375	15			21,800	695
Squeteague	215,620	26,645			2,300	225			9,400	660
Striped bass	5,168	469								
Total	562,915	41,583	55,136	1,374	3,885	355	56,630	2,818	121,500	8,669
Total, by seines	580,915	46,083	55,136	1,374	3,885	355	56,630	2,818	121,500	8,669

YIELD OF SHORE FISHERIES OF NORTH CAROLINA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY SEINES—Continued.

Apparatus and species.	New Hanover.		Pender.		Washington.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Purse seines:								
Menhaden.....							300,000	\$1,000
Striped bass.....							18,000	4,500
Shrimp.....							105,040	1,837
Total.....							423,040	7,837
Haul seines:								
Alewives—								
Fresh.....					600,000	\$30,000	600,000	\$30,000
Salted.....					512,200	25,610	512,200	25,610
Black bass.....							533,364	60,977
Bluefish.....	500	\$62	150	\$13			43,559	4,408
Bowfin.....							25,979	242
Butterfish.....							8,850	217
Carp.....							123,472	4,891
Catfish.....	500	15	1,000	30	1,267	76	114,566	2,602
Croaker.....			6,190	244			74,176	2,433
Drum.....			5,500	340			46,831	1,957
Eels.....							1,512	35
Flounders.....	200	30	4,200	290			7,375	408
Gizzard shad.....							9,271	97
Hickory shad.....							19,060	1,522
Kingfish.....	1,500	187					61,160	4,077
Mullet—								
Fresh.....	20,000	1,750	102,500	9,000			447,165	27,940
Salted.....			20,500	2,190			219,900	25,610
Perch, white.....					2,000	100	354,509	14,302
Perch, yellow.....							154,467	7,200
Pigfish.....			8,150	633			47,572	2,122
Pike.....							15,480	1,441
Pinfish.....							30,049	460
Pompano.....	2,300	345					4,448	591
Shad.....					20,800	4,160	73,585	13,307
Sheepshead.....							6,845	385
Spanish mackerel.....							9,805	756
Spot—								
Fresh.....	19,000	1,450	178,200	9,940			458,946	21,820
Salted.....			3,000	335			24,700	2,505
Squeteague.....	3,500	465	21,200	2,485			610,053	42,753
Striped bass.....							31,673	3,255
Suckers.....							4,890	124
Sunfish.....							104,422	1,036
Yellowtail.....	3,000	180	20,000	965			24,500	1,387
Crabs, soft.....							90,009	5,000
Shrimp.....	120,000	3,000					237,000	6,254
Turtles.....							2,000	11
Total.....	170,500	7,484	370,500	26,505	1,136,267	60,003	5,605,200	332,908
Total, by seines.....	170,500	7,484	370,500	26,505	1,136,267	60,003	5,605,200	332,908

BY GILL NETS.

Species.	Beaufort.		Bladen.		Brunswick.		Camden.		Carters.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Alewives: Fresh.....									45,000	\$2,380
Bluefish.....									242,455	22,088
Bonito.....									1,015	27
Butterfish.....									8,975	452
Cero.....									1,758	97
Croaker.....					300	\$9			167,201	5,120
Drum.....									10,250	320
Flounders.....					2,300	108			1,475	83
Hickory shad.....									10,008	1,169
Kingfish.....					1,100	110			100,213	1,106
Menhaden.....									1,740,000	1,395
Mullet:										
Fresh.....					6,000	400			67,225	4,165
Salted.....					50,000	6,000			22,500	4,000
Pigfish: Fresh.....									128,550	4,270
Pinfish.....									13,380	150
Pompano.....									1,353	147
Shad.....	10,440	\$1,740	3,900	\$1,140	2,050	425	17,800	\$4,450	16,124	4,792
Sheepshead.....					300	18			9,264	538
Spanish mackerel.....									98,375	9,757
Spot:										
Fresh.....					3,500	130			588,395	22,203
Salted.....					15,000	1,200			1,121,327	95,152
Squeteague: Fresh.....					6,000	500			25	3
Striped bass.....					1,000	100			6,608	187
Yellowtail.....									19,125	2,866
Shark hides.....									11,050	2,137
Other aquatic hides.....									5,500	230
Shrimp.....									2,000	13
Turtles.....					500	13				
Total.....	10,440	1,740	3,900	1,140	88,050	9,013	17,800	4,450	4,386,451	194,907

YIELD OF SHORE FISHERIES OF NORTH CAROLINA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY GILL NETS—Continued.

Species.	Chowan.		Columbus.		Craven.		Currituck.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Alewives:								
Fresh.....	4,750	\$120						
Salted.....	1,900	48						
Catfish.....					1,100	\$22		
Croaker.....					350	17		
Flounders.....					250	15		
Hickory shad.....	15,010	1,900			10,940	690		
Mullet: Fresh.....					17,400	1,395		
Perch: White.....					1,400	140		
Shad.....	79,792	17,404	1,575	\$450	9,283	2,433	13,284	\$2,214
Spot: Fresh.....					4,500	194		
Squeteague: Fresh.....					910	83		
Striped bass.....	7,980	1,596			500	50	250	50
Total.....	109,432	21,068	1,575	450	46,638	5,039	13,534	2,264

Species.	Dare.		Gates.		Hertford.		Hyde.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Alewives: Fresh.....			21,688	\$347				
Bluefish.....	15,000	\$1,200					6,600	\$748
Drum.....	16,500	210					250	3
Flounders.....							225	11
Kingfish.....							835	50
Mullet: Salted.....							650	169
Pigfish:								
Fresh.....	15,000	600					500	25
Salted.....	3,125	63						
Pinfish.....	750	15						
Shad.....	151,634	43,512			125	\$25	38,961	6,202
Sheepshead.....	714	50						
Spanish mackerel.....	1,000	50					85	10
Spot:								
Fresh.....	15,000	600					2,500	125
Salted.....	3,125	63						
Squeteague: Fresh.....	6,667	500					14,500	1,114
Sturgeon.....	1,337	328						
Sturgeon caviar.....	311	697						
Total.....	230,163	47,888	21,688	347	125	25	65,166	8,457

Species.	New Hanover.		Onslow.		Pamlico.		Pender.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Alewives: Fresh.....	15,000	\$1,200	177,507	\$6,250				
Bluefish.....			3,400	280				
Butterfish.....					250	\$10		
Croaker.....			9,050	230	1,250	50	400	\$30
Drum.....					5,000	60		
Eels.....			1,645	164				
Flounders.....	100	15						
Hickory shad.....	5,000	400						
Kingfish.....	200	25	18,250	1,220			300	23
Mullet:								
Fresh.....	12,000	1,000	157,024	12,465	4,000	400	29,300	2,250
Salted.....			11,500	1,262	5,800	800	5,000	500
Pigfish: Fresh.....	3,000	300	9,000	350			50	3
Shad.....	38,690	11,275					1,000	275
Sheepshead.....			300	15	850	50		
Spanish mackerel.....	1,500	225			100	10		
Spot: Fresh.....	12,000	900	55,250	3,260	1,250	50	25,100	1,510
Squeteague:								
Fresh.....			94,451	8,593	21,850	1,315	600	45
Salted.....					80	10		
Sturgeon.....	3,500	420						
Sturgeon caviar.....	10	10						
Yellowtail.....					170	5		
Terrapin.....			150	35				
Total.....	90,910	15,770	537,527	34,124	40,600	2,760	61,650	4,636

YIELD OF SHORE FISHERIES OF NORTH CAROLINA IN 1918, BY APPARATUS, COUNTIES,
AND SPECIES—Continued.

BY GILL NETS—Continued.

Species.	Pettiguanus.		Tyrrell.		Washington.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Alwives:								
Fresh.....	68,000	\$1,360			36,500	\$815	368,445	\$12,472
Salted.....	13,000	130					14,900	178
Bluefish.....							267,515	24,286
Bonito.....							1,015	27
Butterfish.....							9,225	462
Carp.....					71	5	71	3
Catfish.....					300	15	1,400	37
Cero.....							1,788	38
Croaker.....							178,551	5,436
Drum.....							32,000	593
Eels.....							1,645	164
Flounders.....							4,350	232
Hickory shad.....					6,125	735	53,983	4,404
Kingfish.....							120,898	8,534
Menhaden.....							1,740,000	7,385
Mullet:								
Fresh.....							292,849	22,075
Salted.....							95,450	12,731
Perch:								
White.....							1,400	140
Yellow.....	625	30					625	50
Pigfish:								
Fresh.....							136,100	5,525
Salted.....								3,125
Pinfish.....							14,130	165
Pompano.....							1,353	147
Shad.....	100,600	21,920	875	\$175	36,844	5,253	521,982	123,585
Sheepshead.....							11,428	671
Spanish mackerel.....							101,260	10,633
Spot:								
Fresh.....							657,495	29,062
Salted.....							18,125	1,263
Squeteague:								
Fresh.....							1,266,505	107,392
Salted.....							80	10
Striped bass.....	7,250	1,450	988	238			17,993	3,487
Sturgeon.....							4,837	748
Sturgeon caviar.....							321	707
Yellowtail.....							6,778	192
Shark hides.....							19,125	2,588
Other aquatic hides.....							1,050	157
Shrimp.....							5,500	230
Terrapin.....							150	75
Turtles.....							2,900	26
Total.....	198,475	24,910	1,864	413	69,840	8,523	5,995,917	286,224

BY POUND NETS.

Species.	Beaufort.		Bertie.		Carteret.		Chowan.		Currituck.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Alwives:										
Fresh.....	189,500	\$3,700	211,845	\$4,236	30,636	\$1,394	4,742,768	\$98,295	40,505	\$2,270
Salted.....			216,030	5,906			3,228,125	87,720	12,082	416
Angelfish.....					3,800	155				
Bluefish.....					1,600	90				
Bonito.....					2,000	80				
Butterfish.....	70,000	4,125			57,224	3,680				
Catfish.....	6,400	160	982	20			62,727	2,218	8,125	375
Cero.....					500	50				
Crevalle.....					204	11				
Croaker.....					45,500	1,355				
Drum.....					2,000	37				
Eels.....	835	25					6,860	549		
Flounders.....	5,800	348			2,550	148			3,348	230
Gizzard shad.....							34,629	1,036		
Hickory shad.....	2,700	213	628	31	6,703	280	43,273	3,932		
Kingfish.....					1,750	85				
Menhaden.....					2,000	12				
Perch:										
White.....	2,785	257	2,261	121			72,800	6,333	7,242	319
Yellow.....	1,757	123							2,416	106
Pigfish.....					600	18				
Pike.....							294	28		
Pompano.....	750	60			625	90				
Shad.....	43,017	7,743	5,366	1,182	37,870	8,961	93,680	17,332	13,812	3,125
Sheepshead.....					1,000	60				
Spanish mackerel.....					6,850	620				
Spot.....					2,000	60				
Squeteague.....	130,600	4,912			288,019	14,314				
Striped bass.....	18,807	2,633	333	50	970	130	9,898	1,981	34,063	5,311
Sturgeon.....					540	27				
Suckers.....			131	8			8,603	383		
Turtles.....					3,500	20				
Total.....	392,060	24,422	437,585	11,527	497,841	31,677	8,303,837	219,807	133,301	12,155

YIELD OF SHORE FISHERIES OF NORTH CAROLINA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY POUND NETS—Continued.

Species.	Craven.		Dare.		Gates.		Hertford.		Hyde.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Alewives:										
Fresh	200	\$10	777,636	\$36,700	52,000	\$832	162,656	\$3,904	87,706	\$3,054
Salted			128,355	4,547						
Angelfish	50	2							5,125	183
Black bass			3,686	442						
Butterfish	30,000	1,200	437,473	12,345					39,626	978
Catfish	100	2	33,081	1,631					2,560	64
Caviar			350	790						
Croaker			5,387	186					1,983	43
Drum									1,100	11
Eels									333	10
Flounders	100	4	19,567	977					10,556	383
Hickory shad	1,000	50	7,467	684					15,112	730
Kingfish			11,815	420					2,500	69
Perch:										
White	300	30	29,701	1,195			792	48	3,078	277
Yellow									700	49
Pigfish									2,250	55
Pompano	25	2	204	12					1,280	92
Shad	2,665	665	729,636	175,760	600	120			70,866	12,194
Spanish mackerel	250	200	21,873	1,761					2,902	232
Spot	300	15	629	12					450	10
Squeteague	20,000	800	578,951	20,555					133,164	3,648
Striped bass	375	75	125,672	18,167					10,829	1,509
Sturgeon			1,539	199						
Total	55,365	3,055	2,922,822	276,782	52,600	952	163,448	3,952	392,130	23,591

Species.	Pamlico.		Perquimans.		Tyrrell.		Washington.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Alewives:										
Fresh	3,750	\$125	82,000	\$1,640	762,350	\$10,417	31,600	\$1,044	7,183,952	\$167,664
Salted			26,000	260	1,151,383	27,623	308,791	7,411	5,070,776	133,913
Angelfish									8,975	340
Black bass									3,686	442
Bluefish									1,000	90
Bonito									2,000	80
Butterfish	80,900	1,645							715,232	23,976
Carp							2,357	165	2,357	165
Catfish					6,350	381	12,180	609	132,505	5,460
Caviar									350	790
Cero									500	50
Crevaille									204	11
Croaker	5,000	100							57,880	1,684
Drum	6,665	50							9,765	98
Eels									10,338	815
Flounders							2,310	231	42,571	2,162
Gizzard shad							650	52	35,154	1,057
Hickory shad							525	21	85,400	6,972
Kingfish							8,517	1,022	16,065	574
Menhaden									2,000	12
Perch:										
White					8,806	838	28,000	2,800	156,852	12,308
Yellow			1,250	100					16,023	777
Pigfish									2,850	73
Pike									294	28
Pompano									2,884	256
Shad	20,220	3,750	25,000	5,000	875	175	17,745	3,472	1,061,382	239,479
Sheepshead									1,000	60
Spanish mackerel	1,000	100							32,875	2,913
Spot									3,379	97
Squeteague	177,100	4,130							1,347,843	48,359
Striped bass			2,000	400	987	237	6,450	1,290	210,284	31,785
Sturgeon									2,079	226
Suckers							2,750	165	11,574	556
Turtles									3,500	20
Total	294,665	9,069	136,250	7,400	1,930,541	39,671	422,775	18,372	16,233,529	683,292

YIELD OF SHORE FISHERIES OF NORTH CAROLINA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY FYKE NETS.

Species.	Camden.		Currituck.		Gates.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Alewives.....			6,710	\$167		
Black bass.....			14,075	1,718		
Bowfin.....			8,393	77		
Carp.....			27,200	818		
Catfish.....	2,400	\$120	35,226	528	312	\$35
Crappie.....					340	66
Perch:						
White.....	2,300	230	101,277	4,050		
Yellow.....			52,386	2,065	312	55
Pike.....			4,778	429		
Striped bass.....			1,943	253		
Sunfish.....			19,558	176		
Total.....	4,700	350	271,615	10,311	964	118

Species.	Perquimans.		Tyrrell.		Washington.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Alewives.....					6,710	\$167		
Black bass.....					14,075	1,718		
Bowfin.....					8,393	77		
Carp.....					27,200	818		
Catfish.....					600	\$30	38,638	709
Crappie.....	300	\$30	4,700	\$470			5,340	588
Perch:								
White.....					750	60	104,327	4,240
Yellow.....							52,998	2,120
Pike.....							4,778	429
Striped bass.....							1,943	253
Sunfish.....							19,558	176
Total.....	300	30	4,700	470	1,350	96	283,629	11,355

BY STOP NETS.

Species.	Brunswick.		Total.		Species.	Brunswick.		Total.	
	Pounds.	Value.	Pounds.	Value.		Pounds.	Value.	Pounds.	Value.
Croaker.....	200	\$9	200	\$9	Squeteague.....	500	\$34	500	\$34
Drum.....	1,500	73	1,500	73	Tautog.....	150	9	150	9
Flounders.....	4,500	265	4,500	265	Crabs:				
Klingfish.....	150	8	150	8	Hard.....	650	20	650	20
Mullet.....	1,500	9	1,500	9	Soft.....	40	10	40	10
Pigfish.....	150	9	150	9	Total.....	10,840	605	10,840	605
Sheepshead.....	1,500	88	1,500	88					

BY LINES.

Apparatus and species.	Brunswick.		Carteret.		Dare.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Hand lines:						
Bluefish.....			1,300	\$100		
Croaker.....			4,200	110		
Flounders.....			7,325	25		
Pigfish.....			7,500	175		
Sea bass.....	1,000	\$70	12,150	1,038		
Sheepshead.....			450	35		
Spanish mackerel.....			5,000	500		
Spot.....	150	7				
Squeteague.....			41,800	3,375		
Total.....	1,150	77	72,725	5,358		
Trot lines: Crabs, hard.....					142,290	\$1,775
Total, by lines.....	1,150	77	72,725	5,358	142,290	1,775

YIELD OF SHORE FISHERIES OF NORTH CAROLINA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY LINES—Continued.

Apparatus and species.	New Hanover.		Onslow.		Pender.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Hand lines:								
Bluefish.....					500	\$38	1,800	\$138
Croaker.....					800	30	5,000	140
Drum.....	8,000	\$480			800	40	8,800	520
Flounders.....	5,000	750					5,325	775
Grunts.....	15,000	1,150					15,000	1,150
Kingfish.....	300	37					300	37
Pinfish.....	45,000	4,500			2,500	185	55,000	4,860
Sailor's choice.....	6,000	600					6,000	600
Sea bass.....	50,000	5,000	200	\$25	800	70	64,150	6,204
Sheepshead.....	5,000	600					5,450	635
Spanish mackerel.....							5,000	500
Spot.....							150	7
Squeteague.....	10,000	1,300	45	5	2,000	240	53,845	4,020
Turtles.....	400	20					400	20
Total.....	144,700	14,437	245	30	7,400	603	226,220	20,505
Set lines: Catfish.....	17,500	975					17,500	975
Trot lines: Crabs, hard.....							142,200	1,778
Total, by lines.....	162,200	15,412	245	30	7,400	603	386,010	23,258

BY OTTER TRAWLS.

Species.	Brunswick.		Carteret.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Croaker.....	1,000	\$25			1,000	\$25
Flounders.....	2,000	60			2,000	60
Kingfish.....	2,000	60			2,000	60
Spots.....	3,000	90			3,000	90
Squeteague.....	2,000	60			2,000	60
Shrimp.....	360,000	10,800	222,580	\$4,054	582,580	14,854
Total.....	370,000	11,095	222,580	4,054	592,580	15,149

BY DREDGES AND CRAB DRAGS.

Apparatus and species.	Beaufort.		Carteret.		Hyde.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Oyster dredges: Oysters, market, public.....	20,405	\$1,165			7,000	\$400
Scallop dredges: Scallops.....			404,448	\$20,726		
Total.....	20,405	1,165	404,448	20,726	7,000	400
Crab drags: Crabs, soft.....			38,660	3,725		

Apparatus and species.	Onslow.		Pamlico.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Oyster dredges: Oysters, market, public.....			103,250	\$4,620	130,655	\$6,185
Scallop dredges: Scallops.....	7,260	\$850			411,708	30,576
Total.....	7,260	850	103,250	4,620	542,363	36,761
Crab drags: Crabs, soft.....					38,660	3,725

YIELD OF SHORE FISHERIES OF NORTH CAROLINA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY TONGS, RAKES, AND HAND.

Apparatus and species.	Beaufort.		Brunswick.		Carteret.		Dare.		Hyde.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Tongs:										
Clams, hard.....			4,000	\$750	3,000	\$845				
Oysters, market, public.....	1,400	\$100			275,884	7,368	30,900	\$2,850	24,500	\$1,900
Total.....	1,400	100	4,000	750	278,884	8,213	30,900	2,850	24,500	1,900
Rakes:										
Clams, hard.....			40,000	7,600	43,576	7,127	6,400	1,200		
Scallops.....					900	105				
Total.....			40,000	7,600	44,476	7,232	6,400	1,200		
Hand:										
Clams, hard.....					600	131				
Oysters, market, public.....			4,725	500	90,559	2,190				
Scallops.....					10,224	937				
Terrapin.....					60	57				
Total.....			4,725	500	101,443	3,305				

Apparatus and species.	New Hanover.		Onslow.		Pamlico.		Pender.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Tongs:										
Clams, hard.....			2,000	\$485					9,000	\$2,000
Oysters, market—										
Public.....			18,025	3,050	54,684	\$2,210			414,393	10,978
Private.....			14,700	2,500	3,500	400			18,200	2,900
Total.....			34,725	6,035	58,184	2,610			441,593	21,878
Rakes:										
Clams, hard.....	48,000	\$14,500	3,600	1,010			35,200	\$9,800	176,776	\$4,257
Oysters, market, public.....							7,000	500	7,000	500
Scallops.....									900	105
Total.....	48,000	14,500	3,600	1,010			42,200	10,300	184,676	\$4,862
Hand:										
Clams, hard.....			11,200	3,150					11,800	\$3,281
Oysters, market, public.....	10,500	600	6,125	700			7,000	500	118,909	\$4,480
Scallops.....									10,224	937
Terrapin.....									60	57
Total.....	10,500	600	17,325	3,850			7,000	500	140,993	\$8,735

BY POTS AND GIGS.

Apparatus and species.	Beaufort.		Carteret.		Craven.		Currituck.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Pots: Eels.....	36,817	\$1,006	1,500	\$150	500	\$40	112,581	\$10,268
Gigs: Flounders.....			3,000	290				

Apparatus and species.	Dare.		New Hanover.		Onslow.		Pender.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Pots: Eels.....	8,000	\$680			1,648	\$165			161,046	\$12,309
Gigs: Flounders.....			5,000	\$750	4,000	310	13,000	\$1,710	25,000	\$3,000

YIELD OF SHORE FISHERIES OF NORTH CAROLINA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY SCOOP, DIP, AND BOW NETS.

Apparatus and species.	Bladen.		Carteret.		Halifax.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Scoop and dip nets:	87	\$25				
Shad.....						
Crabs—						
Hard.....			2,000	\$150		
Soft.....			101,996	11,096		
Total.....	87	25	103,996	11,246		
Bow nets: Striped bass.....					6,635	\$2,770

Apparatus and species.	New Hanover.		Washington.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Scoop and dip nets:						
Alewives.....			250,000	\$20,000	250,000	\$20,000
Shad.....					87	25
Crabs—						
Hard.....	665	\$35			2,665	185
Soft.....					101,996	11,096
Total.....	665	35	250,000	20,000	357,748	31,276
Bow nets: Striped bass.....					6,635	2,770

INDUSTRIES.

Menhaden industry.—In 1918 there were 21 factories in operation as compared with 9 in 1902 and 6 in 1897. These 21 factories were valued at \$905,436, employing cash capital to the amount of \$66,800, and gave employment to 599 persons, to whom \$260,037 were paid in wages. These plants handled 179,910,599 pounds of menhaden, valued at \$1,306,489. Manufactured products included 979,068 gallons of oil, valued at \$761,588, of which 720 gallons, valued at \$540, was shark oil; and 23,088 tons of dried and acidulated scrap, valued at \$1,290,614. Other by-products of the fisheries of the State included 3,100 tons of ground oyster shells, valued at \$18,600, and 20,175 pounds of shark and other aquatic hides, valued at \$3,025, the total value of by-products being \$2,073,827.

Wholesale trade.—In 1918 there were 46 wholesale fishery establishments in the coastal region of North Carolina handling fresh and salt fish, oysters, clams, and other fishery products, valued at \$158,950, with a cash capital amounting to \$61,750, and engaging 208 persons to whom \$85,475 were paid in wages.

Canning industry.—There were 8 establishments, valued at \$130,715, engaged in canning fishery products and the crushing of oyster shells, employing working capital to the amount of \$30,500, and engaging 500 persons to whom \$49,100 were paid in wages. The products included canned oysters to the value of \$112,334; canned shrimp to the value of \$39,576; canned alewife or river herring roe to the value of \$4,070; canned reddish or red drum to the value of \$450; 392,667 pounds of salted alewives or river herring to the value of \$7,068; and 3,100 tons of crushed oyster shells to the value of \$18,600. The important features of each of the above shore industries are shown in the appended tables.

INDUSTRIES OF NORTH CAROLINA IN 1918.

MENHADEN INDUSTRY.

Item.	Number.	Value.	Item.	Number.	Value.
Establishments.....	21	\$905,436	PRODUCTS.		
Cash capital.....		66,800	Oil.....gallons..	1 979,068	\$761,388
Persons engaged.....	599		Dry scrap.....tons..	9,488	674,830
Wages paid.....		260,037	Acidulated scrap.....do....	13,600	615,764

WHOLESALE TRADE IN FRESH AND SALTED FISH, OYSTERS, CLAMS, SCALLOPS, AND CRABS.

Establishments.....	46	\$158,950	Persons engaged.....	208	
Cash capital.....		61,750	Wages paid.....		\$55,475

PREPARED FISHERY PRODUCTS AND CERTAIN BY-PRODUCTS.

Establishments.....	8	\$130,715	Shrimp, canned:		
Cash capital.....		30,500	No. 1 cans.....cases..	2 9,200	\$38,256
Persons engaged.....	500		No. 1½ cans.....do....	1 550	1,320
Wages paid.....		49,100	Total.....		39,576
PRODUCTS.			Alewife roe, canned: No. 2		
Oysters, canned:			cans.....cases..	2 1,100	4,070
4-ounce cans.....cases..	2 724	1,665	Redfish, canned: No. 2		
Do.....do.....	2 1,700	8,500	cans.....cases..	2 200	450
5-ounce cans.....do....	2 23,389	45,034	Alewives, salted.....pounds..	392,667	7,068
Do.....do.....	2 5,000	26,500	Oyster shells, crushed (ag-		
8-ounce cans.....do....	2 526	2,420	ricultural lime).....pounds..	6,200,000	18,600
10-ounce cans.....do....	2 5,643	28,215			
Total.....		112,334			

¹ Includes 720 gallons of shark oil, valued at \$540.² Four dozen cans per case.² Two dozen cans per case.

FISHERIES OF SOUTH CAROLINA.

The coastal fisheries of South Carolina are less extensive than those of the other South Atlantic States, the products representing only 1.13 per cent of the total quantity and 3.88 per cent of the total value for the region. In 1918 the number of persons employed in the fisheries of this State was 2,000, of whom 103 were on fishing vessels, 20 on vessels transporting fishery products, 1,121 in the shore and boat fisheries, and 756 shoresmen in the wholesale fish establishments and other fishery industries. Compared with 1902, there has been a decrease of 1,713 persons, or 46.14 per cent.

The total investment of the fisheries of the State was \$221,251. This included 43 fishing and transporting vessels, valued at \$39,000, of a net tonnage of 505 tons, and with outfits valued at \$7,840; 690 boats, valued at \$36,410; fishing apparatus used on vessels and boats to the value of \$22,126; shore and accessory property worth \$95,775, and working cash capital to the value of \$20,100.

The total yield of the fisheries in 1918 was 3,746,932 pounds, valued at \$207,690, representing a decrease as compared with 1902 of 4,427,531 pounds, or 54.16 per cent in quantity, and \$55,333, or 21.03 per cent in value. The five most important species arranged in order of value were as follows: Oysters, 2,783,830 pounds, or 397,690 bushels, valued at \$96,542; shad, 167,462 pounds, valued at \$29,085;

sturgeon, including sturgeon caviar, 117,890 pounds, valued at \$22,025; mullet, fresh and salted, 200,750 pounds, valued at \$19,129; and sea bass, 132,000 pounds, valued at \$13,200. Compared with 1902, there has been a decrease in the take of oysters of 292,010 bushels; of shad, of 266,671 pounds; an increase in the catch of sturgeon of 33,275 pounds, but a decrease of 9,535 pounds in the production of caviar; an increase in the catch of mullet of 62,150 pounds; and a decrease in the catch of sea bass amounting to 577,545 pounds. For years there has been a small fishery for sharks for food, the catch in 1918 amounting to 20,000 pounds, a decrease of 70,000 pounds as compared with 1902.

FISHERIES BY COUNTIES.

The following table gives, by counties, the number of persons employed, investment, and products of the fisheries of South Carolina in 1918.

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF SOUTH CAROLINA IN 1918, BY COUNTIES.

Item.	Beaufort.		Charleston.		Colleton.	
	Number.	Value.	Number.	Value.	Number.	Value.
PERSONS ENGAGED.						
On vessels fishing.....	81		6			
On vessels transporting.....			20			
In shore fisheries.....	277		358		80	
Shoemen.....	444		299			
Total.....	802		683		80	
INVESTMENT.						
Vessels fishing:						
Gasoline.....			2	\$3,005		
Tonnage.....			24			
Outfit.....				275		
Sail.....	33	\$20,995				
Tonnage.....	357					
Outfit.....		4,415				
Vessels transporting: Gasoline.....			7	11,000		
Tonnage.....			74			
Outfit.....				1,350		
Boats:						
Sail and row.....	286	8,760	238	4,025	40	\$1,000
Power.....			24	10,900	2	800
Apparatus, vessel fisheries:						
Tongs.....	81	443				
Grabs.....	78	78	6	6		
Apparatus, shore fisheries:						
Haul seines.....			4	60		
Gill nets.....	14	800	25	2,800	41	1,570
Cast nets.....			71	155		
Lines.....		10		505		
Otter trawls.....			1	50		
Tongs and rakes.....	196	1,095	8	36		
Grabs.....	243	242	102	109		
Shore and accessory property.....		55,915		33,045		1,200
Cash capital.....		8,100		10,500		
Total.....		100,833		77,821		4,570
PRODUCTS.						
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Black drum.....			5,000	\$225		
Bluefish.....			1,500	140		
Catfish.....			2,500	100		
Crevalle.....			300	65		
Croaker.....	3,500	\$275	8,800	585		
Flounders.....			1,000	130		
Grunts.....			100	6		
King whiting.....	2,525	300	35,650	4,250		
Mullet, fresh.....			3,300	125		
Pinfish or sailor's choice.....			2,000	130		
Porgies.....			2,000	130		

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF SOUTH CAROLINA IN 1918, BY COUNTIES—Continued.

Item.	Beaufort.		Charleston.		Colleton.	
PERSONS ENGAGED.	Number.	Value.	Number.	Value.	Number.	Value.
Redfish or red drum.....			1,000	\$60		
Sea bass.....			72,000	7,200		
Shad.....	8,762	\$1,400	20,700	3,260	32,600	\$5,110
Sharks.....			20,000	175		
Sheepshead.....			1,500	150		
Skates.....			2,000	15		
Spot, fresh.....	1,000	75	1,200	75		
Squeteague or "sea trout".....	5,000	600	46,500	3,640		
Sturgeon.....	4,101	745	324	97	2,800	504
Sturgeon caviar.....	75	56			70	50
Shrimp.....			55,400	6,220		
Crabs:						
Hard.....			18,000	400		
Soft.....			300	75		
Clams, hard.....			800	200		
Terrapin.....			1,275	545		
Oysters, market:						
Public.....	1,562,085	49,023	1,069,670	34,869		
Private.....	133,000	9,300	19,075	3,350		
Total.....	1,720,048	61,764	1,391,894	66,217	35,470	5,664

Item.	Georgetown.		Horry.		Total.	
PERSONS ENGAGED.	Number.	Value.	Number.	Value.	Number.	Value.
On vessels fishing.....	16				103	
On vessels transporting.....					20	
In shore fisheries.....	192		214		1,131	
Shoreshmen.....	8		5		736	
Total.....	216		219		2,000	
INVESTMENT.						
Vessels fishing:						
Gasoline.....	1	\$4,000			8	\$,005
Tonnage.....	50				74	
Outfit.....		1,800				2,075
Sail.....					33	20,095
Tonnage.....					357	
Outfit.....						4,415
Vessels transporting: Gasoline.....					7	11,000
Tonnage.....					74	
Outfit.....						1,350
Boats:						
Sail and row.....	46	1,030	29	\$965	639	15,810
Power.....	24	8,750	1	150	51	20,600
Apparatus, vessel fisheries:						
Lines.....		100				100
Tongs.....					81	443
Grabs.....					84	84
Apparatus, shore fisheries:						
Haul seines.....	5	390	16	2,100	25	2,350
Gill nets.....	153	11,355			283	16,025
Stop nets.....			2	130	2	10
Bow nets.....	5	25			5	25
Cast nets.....					71	153
Digs or spears.....	25	20	10	7	35	27
Lines.....						515
Otter trawls.....	1	40			2	90
Tongs and rakes.....					201	1,118
Grabs.....					345	3,328
Shore and accessory property.....		4,165		1,450		95,175
Cash capital.....		1,500				30,100
Total.....		33,175		4,832		221,234

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF SOUTH CAROLINA IN 1918, BY COUNTIES—Continued.

Item.	Georgetown.		Horry.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
PRODUCTS.						
Alewives.....	9,500	\$475			9,500	\$475
Black drum.....					5,000	225
Bluefish.....			1,500	\$135	3,000	275
Butterfish.....			600	45	600	45
Catfish.....	400	8			2,900	108
Crevaille.....					300	65
Croaker.....	1,300	88	2,400	114	16,000	1,052
Flounders.....	14,500	875	700	56	16,200	1,031
Grunts.....					100	6
Hickory shad.....	20,500	2,000			20,500	2,000
King whiting.....	250	17	1,700	140	40,125	4,707
Mullet:						
Fresh.....	35,600	2,495	19,150	1,603	58,050	4,223
Salted.....	3,400	370	139,300	14,536	142,700	14,906
Pinfish or sailer's choice.....			300	18	2,300	148
Porgies.....					2,000	130
Redfish or red drum.....					1,000	60
Sea bass.....	60,000	6,000			132,000	13,200
Shad.....	105,400	19,315			167,462	29,085
Sharks.....					20,000	175
Sheepshead.....			600	60	2,100	210
Skates.....					2,000	15
Spot:						
Fresh.....	20,000	1,000	14,800	1,144	37,000	2,354
Salted.....			25,550	2,085	25,550	2,085
Squeteague or "sea trout".....	3,550	246	4,100	360	59,150	4,846
Sturgeon.....	110,000	19,800			117,225	21,136
Sturgeon caviar.....	520	783			665	889
Sunfish.....			3,000	180	3,000	180
Yellowtail or "silver perch".....	400	12	500	25	960	37
Shrimp.....					55,400	6,220
Crabs:						
Hard.....					18,000	400
Soft.....					2,300	75
Clams, hard.....					800	200
Terrapin.....					1,275	545
Oysters, market:						
Public.....					2,631,755	83,892
Private.....					152,075	12,650
Total.....	385,320	53,544	214,200	20,501	3,746,932	207,690

1 54,000 in number.

2 900 in number.

3 100 bushels.

4 375,965 bushels.

5 21,725 bushels.

FISHERIES BY APPARATUS.

The combined yield of the vessel and shore fisheries of South Carolina in 1918 with all forms of apparatus amounted to 3,746,932 pounds, valued at \$207,690. Grabs were the most productive form of gear used, taking 283,288 bushels of oysters, valued at \$67,139. The catch with gill nets, consisting chiefly of shad and sturgeon, amounted to 350,902 pounds, valued at \$55,827. The catch of oysters with tongs amounted to 114,402 bushels, valued at \$29,403. Sea bass, king whiting, and squeteague were the principal species taken with lines, the total catch with this form of apparatus being 291,575 pounds, valued at \$24,751. The catch with seines was 237,375 pounds, valued at \$22,439, of which 176,350 pounds, valued at \$17,531, were mullet.

The two leading forms of apparatus used in the shore fisheries were gill nets and grabs. Other kinds of gear used in the shore fisheries were seines, cast nets, otter trawls, gigs, stop nets, bow nets, and rakes.

Only three forms of fishing apparatus were employed in the vessel fisheries, namely, grabs, tongs, and lines.

The products of the vessel and shore or boat fisheries are shown in the following tables:

YIELD OF VESSEL FISHERIES OF SOUTH CAROLINA IN 1918, BY COUNTIES, APPARATUS, AND SPECIES.

Apparatus and species.	Beaufort.		Charleston.		Georgetown.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Lines: Sea bass.					60,000	\$6,000	60,000	\$6,000
Tongs: Oysters, market, public.	440,048	\$12,216					440,048	12,216
Graals: Oysters, market, public.	435,148	12,076	66,500	\$13,976			501,648	26,052
Total.	875,196	24,292	66,500	13,976	60,000	6,000	1,001,696	44,268

YIELD OF SHORE FISHERIES OF SOUTH CAROLINA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES.

BY GILL NETS.

Species.	Beaufort.		Charleston.		Georgetown.		Colleton.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Alewives.					9,500	\$475			9,500	\$475
Catfish.					400	8			400	8
Croaker.					700	47			700	47
Flounders.					500	25			500	25
Hickory shad.					19,250	1,900			19,250	1,900
King whiting.					200	14			200	14
Mullet:										
Fresh.					19,500	1,300			19,500	1,300
Salted.					1,000	125			1,000	125
Shad.	8,762	\$1,400	20,700	\$3,250	165,400	19,315	32,600	\$5,110	167,462	29,085
Spots.					13,000	720			13,000	720
Squeteague.					1,500	103			1,500	103
Sturgeon.	4,101	735	324	97	110,000	19,800	2,800	504	117,225	21,136
Sturgeon caviar.	75	59			520	783	70	50	665	889
Total.	12,938	2,191	21,024	3,357	281,470	41,615	35,470	5,664	350,902	55,827

BY ALL OTHER APPARATUS.

Apparatus and species.	Beaufort.		Charleston.		Georgetown.		Horry.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Selnes:										
Bluefish.							1,500	\$135	1,500	\$135
Butterfish.							600	45	600	45
Croaker.					600	\$41	2,400	114	3,000	155
Flounders.					2,000	103	600	48	2,600	148
King whiting.					50	3	1,700	140	1,750	143
Mullet—										
Fresh.					16,100	1,195	18,550	1,555	34,650	2,750
Salted.					2,400	245	139,700	14,536	141,700	14,781
Sailor's choice.							300	18	300	18
Sheepshead.							600	60	600	60
Spot—										
Fresh.					7,000	340	13,800	1,064	20,800	1,404
Salted.							18,550	1,535	18,550	1,535
Squeteague.					2,050	143	4,100	360	6,150	508
Sunfish.							3,000	180	3,000	180
Yellowtail.					400	12	500	25	900	57
Terrapin.			1,275	\$545					1,275	545
Total.			1,275	545	30,600	2,079	205,500	19,815	237,375	22,439
Otter trawls:										
Shrimp.			30,000	1,200					30,000	1,200
Bow nets: hickory shad.					1,250	100			1,250	100

YIELD OF SHORE FISHERIES OF SOUTH CAROLINA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY ALL OTHER APPARATUS—Continued.

Apparatus and species.	Beaufort.		Charleston.		Georgetown.		Horry.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Cast nets:										
Catfish.....			1,000	\$25					1,000	\$25
Croaker.....			800	25					800	25
Mullet.....			3,300	125					3,300	125
Shrimp.....			25,400	5,020					25,400	5,020
Total.....			30,500	5,195					30,500	5,195
Stop nets:										
Flounders.....							100	\$8	100	8
Mullet.....							600	48	600	48
Spots—										
Fresh.....							1,000	80	1,000	80
Salted.....							7,000	550	7,000	550
Total.....							8,700	686	8,700	686
Gigs or spears:										
Flounders.....					12,000	\$750			12,000	750
Lines:										
Black drum.....			5,000	225					5,000	225
Bluefish.....			1,500	140					1,500	140
Catfish.....			1,500	75					1,500	75
Channel bass.....			1,000	60					1,000	60
Crevalle.....			300	65					300	65
Croaker.....	3,500	\$275	8,000	560					11,500	835
Flounders.....			1,000	130					1,000	130
Grunt.....			100	6					100	6
King whiting.....	2,525	300	35,650	4,250					38,175	4,550
Porgy.....			2,000	130					2,000	130
Sailor's choice.....			2,000	130					2,000	130
Sea bass.....			72,000	7,200					72,000	7,200
Sheepshead.....			1,500	150					1,500	150
Spots.....	1,000	75	1,200	75					2,200	150
Squeteague.....	5,000	600	40,500	3,640					51,500	4,240
Sharks.....			20,000	175					20,000	175
Skates.....			2,000	15					2,000	15
Crabs—										
Hard.....			18,000	400					18,000	400
Soft.....			300	75					300	75
Total.....	12,025	1,250	219,550	17,501					231,575	18,751
Tongs: Oysters, market—										
Public.....	304,941	11,987	1,750	250					306,691	12,237
Private.....	46,500	3,450	8,575	1,500					54,075	4,950
Total.....	350,441	15,437	10,325	1,750					360,766	17,187
Crabs: Oysters, market—										
Public.....	881,948	12,744	1,001,420	20,643					1,883,368	33,387
Private.....	87,500	5,850	10,500	1,850					98,000	7,700
Total.....	969,448	18,594	1,011,920	22,493					1,981,368	41,087
Rakes, Clams, hard.....			800	200					800	200

¹ Taken with the hands.

INDUSTRIES.

Wholesale trade.—In 1918 there were 6 wholesale establishments, valued at \$51,820, with cash capital amounting to \$8,100, employing 59 persons, to whom \$40,678 were paid in wages.

Oyster-canning industry.—In addition to those given above, there were 9 establishments engaged in the canning of oysters and utilization of shells, valued at \$121,925, using cash capital to the amount of

\$12,000, employing 592 persons, to whom \$60,985 were paid in wages during the year. The pack amounted to 2,769,168 cans of various sizes, valued at \$338,843.

The following table contains statistics of the canning industry for South Carolina in 1918:

OYSTER-CANNING INDUSTRY IN SOUTH CAROLINA IN 1918.

Item.	Number.	Value.	Item.	Number.	Value.
Establishments.....	9	\$121,925	PRODUCTS—continued.		
Cash capital.....		12,000	Oysters canned—Continued.		
Persons engaged.....	592		5-ounce cans.....cases..	2 50,496	\$154,028
Wages paid.....		60,985	Do.....do.....	2 23,705	117,253
PRODUCTS. ¹			6-ounce cans.....do.....	2 100	860
Oysters canned:			8-ounce cans.....do.....	2 1,826	7,690
3-ounce cans.....cases..	2 401	1,746	10-ounce cans.....do.....	2 9,190	45,700
4-ounce cans.....do.....	2 880	1,822	Total.....		338,843
Do.....do.....	2 2,289	9,822			

¹ The by-products are included with the statistics for Georgia.

² Two dozen cans per case.

³ Four dozen cans per case.

FISHERIES OF GEORGIA.

In 1918 the fisheries of Georgia gave employment to 1,680 persons, of whom 188 were on fishing and transporting vessels, 476 in the shore fisheries, and 1,016 shoresmen in the wholesale fishery trade and oyster and shrimp canning industry.

The investment amounted to \$769,998, which includes 33 fishing and transporting vessels, valued at \$122,663, with a net tonnage of 552 tons and outfits valued at \$41,866; 412 power and other boats, valued at \$86,205; fishing apparatus employed on vessels and boats, valued at \$17,085; shore and accessory property, valued at \$429,779; and cash capital amounting to \$72,400.

The products amounted to 37,153,953 pounds, valued at \$416,043, and represent an increase of 26,051,343 pounds in quantity and \$56,962 in value as compared with 1902. The 5 most important products, arranged in the order of their value, are as follows: Shrimp, 5,793,465 pounds, valued at \$173,990; menhaden, 29,484,600 pounds, valued at \$88,453; oysters, 1,109,822 pounds, or 158,546 bushels, valued at \$73,913; shad, 100,540 pounds, valued at \$26,960; and sea bass, 292,615 pounds, valued at \$23,765. Compared with 1902, there has been an increase in the catch of shrimp of 5,449,338 pounds in quantity and \$165,582 in value, and an increase in the catch of sea bass amounting to 216,115 pounds in quantity and \$17,683 in value; a decrease in the take of oysters amounting to 7,458,178 pounds, or 1,065,454 bushels, in quantity, and \$146,554 in value; a decrease of 928,510 pounds in quantity of shad and \$48,229 in value; a decrease in the catch of mullet amounting to 115,150 pounds in quantity and \$1,883 in the value; and a decrease in the catch of terrapin amounting to 31,196 pounds in quantity and \$10,682 in value. In 1902 there was no fishery for menhaden in the State.

FISHERIES BY COUNTIES.

The following table shows, by counties, the number of persons employed, number and value of vessels, boats and apparatus used, amount of capital invested, and the quantity and value of the products of the fisheries in 1918.

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF GEORGIA IN 1918, BY COUNTIES.

Item.	Bryan.		Camden.		Chatham.	
PERSONS ENGAGED.						
On vessels fishing.....	Number.	Value.	Number.	Value.	Number.	Value.
In shore fisheries.....	21		102		54	
Shoresmen.....			68		183	
			191		316	
Total.....	21		361		553	
INVESTMENT.						
Vessels fishing:						
Gasoline.....			7	\$56,900	7	\$37,040
Tonnage.....			215		176	
Outfit.....				28,233		9,308
Sail.....					5	2,315
Tonnage.....					44	
Outfit.....						325
Boats:						
Sail, row, etc.....	21	\$315	22	1,115	186	5,850
Power.....			25	24,400	10	2,225
Apparatus, vessel fisheries:						
Purse seines.....			4	4,800		
Lines.....						165
Other trawls.....			3	160		
Dredges.....					6	340
Tongs.....					13	76
Grabs.....					13	12
Apparatus, shore fisheries:						
Gill nets.....	21	735	16	1,050	38	1,260
Lines.....				2		
Other trawls.....			23	1,200		
Tongs.....					160	162
Grabs.....					160	162
Shore and accessory property.....		25		77,145		104,130
Cash capital.....				15,000		36,600
Total.....		1,075		233,605		280,543
PRODUCTS.						
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Bluefish.....					3,000	\$900
Cero, or kingfish.....					74	7
Flounders.....					500	55
Groupers.....					27,758	1,019
Grunts.....					512	26
King whiting.....					100	12
Menhaden.....			29,484,600	\$88,453		
Mullet.....					3,000	240
Redfish, or red drum.....					24	4
Red snapper.....					111,749	7,740
Scup.....					12,000	900
Sea bass.....			125	10	291,490	23,655
Shad.....	13,500	\$3,262	61,250	18,000	14,502	3,505
Sharks.....					1,289	30
Sheepshead.....			175	10		
Squeteague, or "sea trout".....			850	50	3,700	885
Striped bass.....			125	10		
Tilfish.....					35,000	2,400
Shrimp.....			1,290,818	39,046		
Oysters, market:						
Public.....			37,800	1,400	412,930	28,364
Private.....					261,079	24,288
Octopus.....					2,731	268
Terrapin.....					2,030	419
Total.....	13,500	3,262	31,875,743	146,979	1,185,468	94,217

**PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF GEORGIA
IN 1918, BY COUNTIES—Continued.**

Item.	Effingham.		Glynn.		Liberty.	
	Number.	Value.	Number.	Value.	Number.	Value.
PERSONS ENGAGED.						
On vessels fishing.....			30			
On vessels transporting.....			2			
In shore fisheries.....	3		116		16	
Shoresmen.....			382		37	
Total.....	3		539		53	
INVESTMENT.						
Vessels fishing:						
Gasoline.....			13	\$25,908		
Tonnage.....			108			
Outfit.....				3,875		
Vessels transporting, gasoline.....			1	500		
Tonnage.....			9			
Outfit.....				125		
Boats:						
Sail, row, etc.....	3	\$45	23	320	14	\$195
Power.....			52	46,725	1	600
Apparatus, vessel fisheries:						
Otter trawls.....			9	545		
Tongs.....			8	60		
Grabs.....			8	12		
Apparatus, shore fisheries:						
Haul seines.....			2	80		
Gill nets.....	3	100	6	15	4	45
Lines.....				6		
Otter trawls.....			48	2,400		
Tongs.....			10	75	12	70
Grabs.....			10	15	12	12
Shore and accessory property.....		5		127,764		13,500
Cash capital.....				18,000		800
Total.....		150		236,425		15,322
PRODUCTS.						
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Croaker.....			5,600	\$235		
Flounders.....			10,000	575		
Hickory shad.....					195	\$25
King whiting.....			26,200	1,397		
Mullet.....			2,500	100		
Redfish, or red drum.....			100	6		
Red snapper.....			600	70		
Sea bass.....			1,000	100		
Shad.....	1,998	\$483			605	111
Spot.....			1,100	59		
Squeteague, or "sea trout".....			27,700	2,962		
Yellowtail, or "silver perch".....			2,000	100		
Crabs, hard.....			8,455	504		
Shrimp.....			4,412,647	132,350		
Clams, hard.....			120	75		
Oysters, market:						
Public.....			5,600	400		
Private.....			115,332	2,141	154,021	6,600
Terrapin.....			82	35		
Turtles.....			11,250	100		
Total.....	1,998	483	4,630,296	141,209	154,821	6,736

Item.	McIntosh.		Wayne.		Total.	
	Number.	Value.	Number.	Value.	Number.	Value.
PERSONS ENGAGED.						
On vessels fishing.....					186	
On vessels transporting.....					2	
In shore fisheries.....	49		20		476	
Shoresmen.....	280				1,016	
Total.....	139		20		1,680	

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF GEORGIA
IN 1918, BY COUNTIES—Continued.

Item.	McIntosh.		Wayne.		Total.	
INVESTMENT.						
Vessels fishing:	Number.	Value.	Number.	Value.	Number.	Value.
Gasoline.....					27	\$119,848
Tonnage.....					499	
Outfit.....						41,416
Sail.....					5	2,315
Tonnage.....					44	
Outfit.....						325
Vessels transporting gasoline..					1	509
Tonnage.....					9	
Outfit.....						125
Boats:						
Sail, row, etc.....	34	\$890	10	\$105	313	8,805
Power.....	11	3,450			99	77,400
Apparatus, vessel fisheries:						
Purse seines.....					4	4,800
Lines.....						105
Otter trawls.....					12	705
Dredges.....					6	340
Tongs.....					21	136
Grabs.....					21	24
Apparatus, shore fisheries:						
Haul seines.....					2	80
Gill nets.....	18	2,425	33	325	139	5,955
Cast nets.....	1	3			1	3
Lines.....		5				13
Otter trawls.....	2	100			73	3,700
Tongs.....	8	60			150	1,040
Grabs.....	28	35			210	224
Shore and accessory property..		17,200		10		429,779
Cash capital.....		3,000				72,400
Total.....		27,138		440		769,998
PRODUCTS.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Bluefish.....					5,000	\$900
Catfish.....	2,675	\$265			2,675	265
Cero, or kingfish.....					74	7
Croaker.....	309	20			5,900	255
Flounders.....	390	20			10,800	650
Groupers.....					27,758	1,019
Grunts.....					512	26
Hickory shad.....	7,887	1,350	4,925	\$660	13,067	2,035
King whiting.....	930	59			27,230	1,468
Menhaden.....					29,484,690	88,453
Mullet.....	3,150	353			10,650	693
Redfish, or red drum.....	1,550	102			1,674	112
Red snapper.....					112,349	7,810
Scup.....					12,000	900
Sea bass.....					292,615	23,765
Shad.....	2,485	519	6,200	1,080	100,540	20,960
Sharks.....					1,289	30
Sheepshead.....	225	15			400	25
Spot.....					1,100	59
Squeteague, or "sea trout".....	7,340	700			39,550	4,097
Striped bass.....					125	10
Sturgeon.....	30,150	4,700			39,150	4,700
Tilefish.....					35,000	2,400
Yellowtail, or "silver perch".....					2,000	100
Crabs, hard.....					8,455	504
Shrimp.....	90,000	2,504			5,793,465	173,980
Clams, hard.....					120	75
Oysters, market:						
Public.....	25,200	730			481,530	30,884
Private.....	97,890	10,600			628,292	43,029
Octopus.....					2,731	268
Terapin.....					2,112	454
Turtles.....					11,250	100
Total.....	281,012	21,417	11,125	1,740	37,153,953	416,043

* 25,365 in number.

* 15 bushels.

* 68,790 bushels.

* 69,726 bushels.

FISHERIES BY APPARATUS.

The yield of all forms of apparatus in Georgia in 1918 amounted to 37,153,953 pounds, valued at \$416,043. In the value of their product, otter trawls, employed chiefly in the taking of shrimp, ranked first, with a catch of 5,838,115 pounds, valued at \$175,705. Exceeding all other forms of apparatus in quantity, but ranking second in the value of their catch, purse seines took 29,484,600 pounds of menhaden, valued at \$88,453. The yield of the gill-net fishery amounted to 203,332 pounds, valued at \$38,705, of which 100,540 pounds, valued at \$26,960, were shad. The catch with lines was 505,712 pounds, valued at \$38,224, the principal species taken by this apparatus in the order of their value being: Sea bass, red snapper, tilefish, and groupers. Oysters were taken with tongs to the amount of 486,444 pounds, or 69,492 bushels, valued at \$32,029, and with grabs to the amount of 468,678 pounds, or 66,954 bushels, valued at \$31,384. The combined take of oysters with these two forms of gear amounted to 136,446 bushels, valued at \$63,413.

Aside from purse seines, lines, and otter trawls used in the vessel fisheries, the only other forms of apparatus employed were dredges, tongs, and grabs, all of which were engaged in taking oysters.

The bulk of the catch in the shore fisheries was made with otter trawls, gill nets, tongs, and grabs, the remainder being taken by hand and with lines, seines, and cast nets.

The products of the vessel and shore or boat fisheries are shown in the appended tables.

YIELD OF VESSEL FISHERIES OF GEORGIA IN 1918, BY COUNTIES, APPARATUS, AND SPECIES.

Apparatus and species.	Camden.		Chatham.		Glynn.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Purse seines: Menhaden....	29,484,600	\$88,453					29,484,600	\$88,453
Lines:								
Bluefish.....			5,000	\$500			5,000	\$500
Cero. or kingfish.....			74	7			74	7
Flournders.....			500	55			500	55
Groupers.....			27,778	1,019			27,778	1,019
Grunts.....			512	26			512	26
Redfish, or red drum.....			21	4			21	4
Red snapper.....			111,749	7,730			111,749	7,730
Scup.....			12,000	100			12,000	100
Sea bass.....			291,499	23,635			291,499	23,635
Sharks.....			1,289	30			1,289	30
Squeteague, or "sea trout".....			2,500	185			2,500	185
Tilefish.....			35,000	2,400			35,000	2,400
Octopus.....			2,731	268			2,731	268
Total.....			490,627	37,189			490,627	37,189
Otter trawl: Shrimp.....	155,655	690			410,865	\$11,800	566,520	16,490
Dredges: Oysters, market, private.....			116,900	9,100			116,900	9,100
Tongs: Oysters, market—								
Public.....			35,900	2,100			35,900	2,100
Private.....			3,500	300	43,120	800	46,620	1,100
Total.....			43,400	2,400	43,120	800	86,520	3,300
Grabs: Oysters, market—								
Public.....			37,275	1,875			37,275	1,875
Private.....			3,500	300	43,078	800	46,678	1,100
Total.....			40,775	2,175	43,078	800	83,853	2,975
Grand total.....	29,640,255	93,953	691,702	50,864	496,863	13,400	30,828,820	157,317

YIELD OF SHORE FISHERIES OF GEORGIA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES.

BY GILL NETS.

Species.	Bryan.		Camden.		Chatham.		Effingham.		Glynn.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Flounders.....					100	\$12			5,000	\$325
King whiting.....					3,000	240			5,000	325
Mullet.....									600	70
Red snapper.....									1,000	100
Sea bass.....	13,500	\$3,262	61,250	\$18,000	11,502	3,505	1,998	\$483		
Shad.....									500	24
Spot.....					1,200	200			25,000	2,800
Squeteague, or "sea trout".....					2,030	419				
Terrapin.....										
Total.....	13,500	3,262	61,250	18,000	20,832	4,376	1,998	483	37,100	3,644

Species.	Liberty.		McIntosh.		Wayne.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Flounders.....			150	\$10			5,150	\$335
Hickory shad.....	195	\$25	7,887	1,350	4,925	\$680	13,007	2,035
King whiting.....			30	2			5,130	339
Mullet.....			4,400	303			7,400	543
Redfish, or red drum.....			650	45			650	45
Red snapper.....							600	70
Sea bass.....							1,000	100
Shad.....	605	111	2,485	519	6,200	1,080	100,540	26,900
Sheepshead.....			75	5			75	5
Spot.....							500	24
Squeteague, or "sea trout".....			1,000	130			28,100	3,130
Sturgeon.....			39,150	4,700			39,150	4,700
Terrapin.....							2,030	419
Total.....	800	136	56,727	7,061	11,125	1,740	203,332	38,705

BY SEINES, OTTER TRAWLS, CAST NETS, LINES, AND HAND.

Apparatus and species.	Camden.		Glynn.		McIntosh.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Sekes:								
Croakers.....			600	\$35			600	\$35
King whiting.....			1,200	72	300	\$17	1,500	89
Mullet.....			2,500	100			2,500	100
Redfish, or red drum.....			100	6	300	17	400	23
Spot.....			600	35			600	35
Squeteague, or "sea trout".....			1,200	72	4,400	500	5,600	572
Crabs, hard.....			120	4			120	4
Shrimp.....			100	25			100	25
Total.....			6,420	349	5,000	534	11,420	883
Otter trawls:								
Croakers.....			5,000	200			5,000	200
Flounders.....			5,000	250			5,000	250
King whiting.....			20,000	1,000			20,000	1,000
Squeteague, or "sea trout".....			1,500	90			1,500	90
Yellowtail, or "silver perch".....			2,000	100			2,000	100
Shrimp.....	1,135,163	\$34,446	1,001,882	120,525	90,080	2,594	5,227,045	157,565
Turtles.....			11,250	100			11,250	100
Total.....	1,135,163	34,446	4,046,632	122,265	90,080	2,594	5,271,795	159,305
Cast nets: Mullet.....					750	50	750	50
Lines:								
Hand lines—								
Croakers.....					300	20	300	20
Flounders.....					150	10	150	10
King whiting.....					600	40	600	40
Redfish, or red drum.....					600	40	600	40
Sea bass.....	125	10					125	10
Sheepshead.....	175	10			150	10	325	20
Squeteague, or "sea trout".....								
Striped bass.....	850	50			1,000	70	1,850	120
Total.....	1,275	80			2,800	190	4,075	270
Set lines—catfish.....					2,675	265	2,675	265
Trotlines—crabs, hard.....			8,335	500			8,335	500
Total, by lines.....	1,275	80	8,335	500	5,475	455	15,085	1,035
Hand:								
Terrapin.....			82	35			82	35
Clams, hard.....			120	75			120	75
Oyster, market, public.....	37,800	1,400					37,800	1,400
Total.....	37,800	1,400	202	110			38,002	1,510

YIELD OF SHORE FISHERIES OF GEORGIA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY TONGS AND GRABS.

Apparatus and species.	Chatham.		Glynn.		Liberty.		McIntosh.		Total.	
Tongs: Oysters, market:	<i>Pounds.</i>	<i>Value.</i>	<i>Pounds.</i>	<i>Value.</i>	<i>Pounds.</i>	<i>Value.</i>	<i>Pounds.</i>	<i>Value.</i>	<i>Pounds.</i>	<i>Value.</i>
Public.....	167,881	\$12,195	2,800	\$200			12,600	\$360	183,281	\$12,755
Private.....	67,536	7,174	16,156	300	84,021	\$3,600	48,930	5,000	216,643	16,074
Total.....	235,417	19,369	18,956	500	84,021	3,600	61,530	5,360	399,924	28,829
Grabs: Oysters, market:										
Public.....	167,874	12,194	2,800	200			12,600	360	183,274	12,754
Private.....	69,643	7,414	12,978	241	70,000	3,000	48,930	5,000	201,551	15,655
Total.....	237,517	19,608	15,778	441	70,000	3,000	61,530	5,360	384,825	28,409

INDUSTRIES.

Wholesale trade.—In 1918 there were 18 establishments, valued at \$237,575, in operation. These used working cash capital to the amount of \$33,000 and gave employment to 223 persons, to whom \$66,900 were paid in wages.

Canning industry.—There were 10 establishments, valued at \$265,444, engaged in canning oysters, shrimp, etc., in preparing cooked shrimp for market, and in crushing oyster shells. These used cash capital to the amount of \$30,300 and gave employment to 634 persons, to whom \$129,075 were paid in wages. The products included canned oysters to the value of \$93,208; canned shrimp to the value of \$355,548; 40 cases of canned flounders, valued at \$200; 464,983 pounds of cooked shrimp, valued at \$103,889; poultry grit from ground oyster shells, 127 tons, valued at \$1,525; and lime from oyster shells, 18 tons, valued at \$99.

PREPARED FISHERY PRODUCTS AND BY-PRODUCTS OF GEORGIA IN 1918.

Item.	Number.	Value.	Item.	Number.	Value.
Establishments.....	10	\$265,444	PRODUCTS—continued.		
Cash capital.....		30,300	Shrimp, canned:		
Persons engaged.....	634		No. 1 cans.....cases..	² 55,706	\$295,967
Wages paid.....		129,075	No. 1½ cans.....do....	¹ 10,740	59,981
PRODUCTS.			Total.....		355,548
Oysters, canned:			Flounders, canned: 10-ounce cans.....cases..	² 40	200
4-ounce cans.....cases..	¹ 500	1,300	Shrimp, cooked:		
5-ounce cans.....do....	¹ 14,799	41,837	Meat.....pounds..	214,684	64,865
Do.....do....	² 6,329	35,576	Headless, cooked.....do....	198,945	33,582
6-ounce cans.....do....	² 50	400	Whole, cooked.....do....	51,354	5,442
10-ounce cans.....do....	¹ 2,364	13,645	Oyster shells:		
12-ounce cans.....do....	¹ 50	400	Crushed, poultry grit, pounds.....	² 254,000	1,525
Total.....		93,208	Lime.....tons..	18	99

¹ Two dozen cans per case.² Four dozen cans per case.³ Includes oyster shells crushed in South Carolina.

FISHERIES OF EAST COAST OF FLORIDA.

The statistics here presented are for the eastern coast of Florida and, among the South Atlantic States, were surpassed only by North Carolina. The number of persons employed was 3,330, of whom 395 were on fishing and transporting vessels, 2,104 in the shore or boat fisheries, and 831 in the wholesale fishery trade, the menhaden industry, and the oyster and shrimp canning industry. Compared with 1902, there has been an increase in the persons employed of 632.

The investment amounted to \$2,210,679, which includes 30 fishing and transporting vessels, valued at \$409,900, with a net tonnage of 814 tons and outfits valued at \$75,137; 839 power boats, valued at \$459,650; 607 sail, row, and other boats, valued at \$20,180; fishing apparatus employed on vessels and boats, valued at \$235,492; shore and accessory property to the value of \$858,720; and working cash capital amounting to \$151,600. Compared with 1902, the increase in the investment amounts to \$1,855,844.

The products of eastern Florida amounted to 81,211,488 pounds, valued at \$1,746,175, an increase of 61,627,223 pounds, or 314.67 per cent, in the quantity and \$1,268,307, or 265.41 per cent, in the value as compared with 1902.

The 10 leading products arranged in order of value follow: Mullet, 10,417,889 pounds, valued at \$397,147; shrimp, 8,867,918 pounds, valued at \$266,651; Spanish mackerel, 3,061,965 pounds, valued at \$218,085; menhaden, 48,362,600 pounds, valued at \$210,175; cero and kingfish, 2,271,792 pounds, valued at \$147,608; squeteague or "sea trout," 1,645,223 pounds, valued at \$142,091; shad, 963,606 pounds, valued at \$135,844; bluefish, 561,301 pounds, valued at \$54,715; red and black drum, 900,091 pounds, valued at \$24,638; and oysters, 458,990 pounds, or 65,570 bushels, valued at \$20,128.

Compared with 1902, the increase in the catch of bluefish amounts to 481,801 pounds, or 606.03 per cent; of red and black drum, to 765,206, or 567.30 per cent; of mullet, to 3,076,973 pounds, or 41.91 per cent; of Spanish mackerel, to 2,402,877 pounds, or 364.57 per cent; of squeteague, to 746,660 pounds, or 83.09 per cent; and of shrimp, to 5,855,064 pounds, or 194.33 per cent. There has been a decrease in the catch of shad as compared with 1902, amounting to 855,825 pounds, or 47.04 per cent; and of oysters, of 1,704,493 pounds, or 243,499 bushels, or 78.78 per cent. No cero, kingfish (not king whiting), or menhaden were included in the returns for 1902.

A comparison of the fisheries of the east and west coast of Florida in 1918 is given on pages 116, 117.

FISHERIES BY COUNTIES.

The statistics of the number of persons engaged, investment, and products of the fisheries of the eastern coast of Florida in 1918, by counties, are given in the table following.

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF THE EAST COAST OF FLORIDA IN 1918, BY COUNTIES.

Item.	Brevard.		Broward.		Dade.		Duval.		Lake.	
	Number.	Value.	Number.	Value.	Number.	Value.	Number.	Value.	Number.	Value.
PERSONS ENGAGED.										
On vessels fishing.					114		214			
On vessels transporting.					9					
In shore fisheries.	228		2		229		167			
Shoresmen.					48		163			
Total.	228		2		400		544			
INVESTMENT.										
Vessels fishing:										
Gasoline.					12	\$89,100	9	\$258,500		
Tonnage.					202		467			
Outfit.						4,143		48,997		
Vessels transporting:										
Gasoline.					5	2,300				
Tonnage.					36					
Outfit.						2,250				
Boats:										
Sail, row etc.	216	\$5,820	1	\$40			20	550	2	\$80
Power.	98	29,100	1	250	124	59,300	73	20,250	1	280
Apparatus, vessel fisheries: Purse seines.					12	22,400	9	22,500		
Apparatus, shore fisheries:										
Haul seines.			1	175			8	280	1	300
Gill nets.	182	26,800			43	6,450	92	12,800		
Cast nets.							6	30		
Dip nets.					3	3				
Lines.		40		5		920		190		
Traps.							20	50		
Cuffs.					3	3				
Tongs.							10	70		
Shore and accessory property.		15,000		50		104,800		\$83,835		500
Cash capital.						18,000		55,000		
Total.		80,700		520		329,675		1,003,052		4,810
PRODUCTS.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Alewives.									30,000	\$450
Amberfish.			150	\$12	200	\$8				
Angelfish.					175	7				
Barracuda.			150	12	200	8				
Black drum.	36,500	\$1,095	160	8			32,400	\$1,020		
Bluefish.			300	60	23,804	1,866	1,600	165		
Blue runner or hardtail.					2,500	82				
Bonito.			100	10	50	3				
Butterfish.					4,200	170				
Cero and kingfish.			300	45	973,331	68,133				
Cowfish and "shellfish"					50	2				
Crevalle.	3,300	132	800	80	800	26				
Flounders.	1,210	48					400	40		
Groupers.			230	20	41,978	2,518				
Grunt.			400	40	10,050	420				
Hogfish.					150	6				
King whiting.	13,900	1,132					32,600	2,240		
Leather jacket or "turbot"					200	8				
Menhaden.							42,635,400	181,201		
Moonfish.			100	8	540	16				
Mullet.	4,292,600	171,704	500	50	2,651,085	90,395	78,000	4,740		
Permit.			50	5						
Pigfish.	2,000	64			100	4				
Pinfish or sailor's choice.	43,150	1,386	200	20	200	10				
Pompano.	100	15	30	6	446	68	240	36		
Porgies.					5,060	300				
Porkfish.					350	17				
Redfish or red drum.	31,400	1,256	100	12			26,400	1,680		
Sea bass.					100	8	20,000	1,600		
Sergeantfish or snook.	430	15	350	28						
Shad.							265,608	36,855	4,850	68

**PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF THE EAST
COAST OF FLORIDA IN 1918, BY COUNTIES—Continued.**

Item.	Brevard.		Broward.		Dade.		Duval.		Lake.	
PRODUCTS—con.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Sharks.....	11,945	\$478	50	\$5	100	\$6	50,000	\$250		
Sheepshead.....							14,000	840		
Snapper:										
Mangrove.....	200	8	600	60	2,700	135				
Mutton.....	1,400	54	700	70	7,500	300				
Red.....							19,200	1,920		
Spanish mackerel.....					870,416	59,808				
Spot.....	29,500	675					1,200	96		
Squeteague or "sea trout".....	591,482	50,291			1,000	80	88,000	7,200		
Yellowtail or "silver perch".....					450	18				
Crabs, hard.....							52,000	1,900		
Sea crawfish or spiny lobster.....					21,408	1,070				
Oysters, market, public.....							31,500	1,800		
Turtles.....					6,000	304				
Total.....	5,050,117	228,353	5,240	551	4,625,742	225,856	43,347,948	243,483	34,850	\$1,128

Item.	Nassau.		Palm Beach.		Putnam.		Seminole.	
PERSONS ENGAGED.	Number.	Value.	Number.	Value.	Number.	Value.	Number.	Value.
On vessels fishing.....	52							
In shore fisheries.....	319		551		142		59	
Shoremen.....	541		42					
Total.....	912		593		142		59	
INVESTMENT.								
Vessels fishing: Gasoline.....	2	\$30,000						
Tonnage.....	56							
Outfit.....		8,147						
Boats:								
Sail, row, etc.....	43	2,380	55	\$1,505	88	\$2,290	49	\$1,225
Power.....	132	151,700	229	130,500	18	5,450	12	2,450
Apparatus, vessel fisheries:								
Purse seines.....	4	8,000						
Apparatus, shore fisheries:								
Purse seines.....			2	3,000				
Haul seines.....			23	18,900	15	3,200	28	1,575
Gill nets.....	16	1,050	181	25,975	36	4,000		
Lines.....				1,570				
Otter trawls.....	250	16,250						
Tongs.....			1	7				
Shore and accessory property.....		500		92,095		3,900		3,000
Cash capital.....		41,000		18,100				
Total.....		262,027		233,652		18,750		8,250

PRODUCTS.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Alewives.....					341,523	\$5,018		
Amberfish.....			11,336	\$370				
Angelfish.....			1,170	37				
Barracuda.....			2,515	76				
Black drum.....			23,950	503				
Bluefish.....			362,339	36,532				
Blue runner or hardtail.....			47,600	1,447				
Bonito.....			7,841	236				
Catfish.....			1,600	32				
Cero and kingfish.....			1,288,161	79,430				
Crevalle.....			61,910	2,021				
Croaker.....			34,388	1,631				
Flounders.....			430	17				
Groppers.....			32,605	1,084				
Grunts.....			18,460	595				
Hogfish.....			100	5				
Jewfish.....			7,117	222				
King whiting.....			13,211	530				
Ladyfish.....			1,280	13				
Leather jacket or "turbot".....			170	5				
Menhaden.....	5,660,000	28,300	57,000	570				
Moonfish.....			7,230	218				

**PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF THE EAST
COAST OF FLORIDA IN 1918, BY COUNTIES—Continued.**

Item.	Nassau.		Palm Beach.		Putnam.		Seminole.	
PRODUCTS—continued.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Mullet.....			1,016,734	\$37,496				
Parrotfish.....			3,500	70				
Permit.....			6,465	213				
Pigfish.....			4,932	148				
Pinfish or sailer's choice.....			34,135	1,034				
Pompano.....			60,029	9,568				
Porpires.....			950	28				
Porkfish.....			1,360	40				
Redfish or red drum.....			32,355	1,167				
Sea bass.....			19,821	1,021				
Sea gar or needlefish.....			100	5				
Sergeantfish or snook.....			81,074	2,604				
Shad.....	61,250	\$18,000			456,471	\$56,786	102,161	\$13,277
Sharks.....			13,350	272				
Sheepshead.....			16,686	608				
Snapper:								
Mangrove.....			16,195	666				
Mutton.....			93,385	2,994				
Red.....			1,000	80				
Spanish mackerel.....			1,493,319	102,200				
Spot.....			31,040	939				
Squeteague or "sea trout".....			135,835	12,567				
Yellowtail or "silver perch".....			20,230	607				
Shrimp.....	8,800,568	264,197						
Sea crawfish or spiny lobster.....			2,095	104				
Oysters, market:								
Public.....	90,293	3,315	2,100	195				
Private.....	135,065	3,994	10,500	1,000				
Turtles.....			250	12				
Conch meat.....			7,000	700				
Total.....	14,853,170	310,806	5,094,853	301,372	790,997	61,804	102,161	13,277

Item.	St. John.		St. Lucie.		Volusia.		Total.	
PERSONS ENGAGED.	Number.	Value.	Number.	Value.	Number.	Value.	Number.	Value.
On vessels fishing.....							380	
On vessels transporting.....			6				15	
In shore fisheries.....	34		280		88		2,104	
Shoresmen.....			37				831	
Total.....	34		323		88		3,330	
INVESTMENT.								
Vessels fishing: Gasoline.....							23	\$377,600
Tonnage.....							725	
Outfit.....								71,287
Vessels transporting: Gasoline.....			2	\$20,000			7	32,300
Tonnage.....			53				89	
Outfit.....				1,600				3,850
Boats:								
Sail, row, etc.....	15	\$375	52	2,185	66	\$1,840	607	20,180
Power.....	9	2,350	120	49,270	22	5,600	839	459,650
Apparatus, vessel fisheries:								
Purse seines.....							25	52,900
Apparatus, shore fisheries:								
Purse seines.....							2	3,000
Haul seines.....	5	750	26	32,100	8	850	115	58,030
Gill nets.....	5	500	115	17,400	45	6,750	715	101,725
Cast nets.....	10	50					16	80
Dip nets.....							3	3
Lines.....		110				100		2,965
Other trawls.....	5	250					255	10,500
Traps.....							50	50
Spears.....	12	12					12	12
Gaffs.....							3	3
Tongs.....	5	30	2	14	14	98	32	219
Hooks.....	5	5					5	5
Shore and accessory property.....		500		45,034		5,500		858,720
Cash capital.....				19,500				151,600
Total.....		5,062		187,083		20,738		2,210,679

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF THE EAST COAST OF FLORIDA IN 1918, BY COUNTIES—Continued.

Item.	St. John.		St. Lucie.		Volusia.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
PRODUCTS.								
Alewives.....					327,739	\$4,905	692,265	\$10,373
Amberfish.....							11,686	390
Angelfish.....			1,570	\$47			2,915	91
Barracuda.....			50	1			2,915	97
Black drum.....	16,932	\$526	407,192	8,408	14,200	618	531,332	12,178
Bluefish.....	900	92	171,648	15,935	650	65	561,301	54,715
Blue runner or hardtail.....			650	13			50,750	1,542
Bonito.....	150	9					8,141	258
Butterfish.....							4,200	170
Catfish.....			12,300	246			13,908	278
Cero and kingfish.....							2,271,792	147,608
Cowfish and "shellfish".....							50	2
Crevalle.....			254,220	7,574			321,039	9,833
Croaker.....	2,150	84	87,740	2,332			124,278	3,447
Flounders.....	7,670	460	2,980	140	800	32	13,490	737
Groupers.....							74,783	3,622
Grunts.....	150	9	84,019	2,559			113,679	3,629
Hogfish.....							250	11
Jewfish.....	220	9	5,150	134			12,487	365
King whiting.....	3,150	176	82,797	4,835	51,950	4,671	297,008	15,604
Ladyfish.....							1,280	13
Leather jacket or "turbot".....							370	13
Menhaden.....			10,200	104			48,362,600	210,175
Moonfish.....			100	3			7,970	245
Mullet.....	12,140	529	1,423,870	54,535	942,960	37,728	10,417,889	397,147
Parrotfish.....							3,500	70
Permit.....	115	5	460	11	200	10	7,290	244
Pigfish.....	300	12	6,630	199	800	24	14,762	451
Pinfish or sailor's choice.....	1,190	47	359,270	10,404	4,400	132	442,535	13,033
Pompano.....	825	124	67,749	9,672	4,000	400	133,419	19,889
Porgies.....							5,950	328
Porkfish.....							1,710	57
Redfish or red drum.....	9,230	431	258,874	7,482	9,400	432	308,759	12,460
Sea bass.....	1,410	70					41,331	2,699
Sea gar or needlefish.....							100	5
Sergeantfish or snook.....			232,920	5,982			314,774	8,629
Shad.....					73,296	10,245	963,606	133,844
Sharks.....			425	4			63,775	526
Sheepshead.....	465	29	60,557	2,125	500	24	104,303	4,115
Snapper.....								
Mangrove.....			3,491	106			23,186	975
Mutton.....			138,083	3,981			241,678	7,399
Red.....							20,200	2,000
Spanish mackerel.....	1,510	151	696,721	55,838			3,061,965	218,085
Spot.....	3,590	144	331,140	9,938	5,590	205	393,030	11,998
Squeteague or "sea trout".....	25,372	1,947	667,534	57,746	136,000	12,260	1,615,221	142,061
Yellowtail or "silver perch".....			25,290	654			43,970	1,279
Shrimp.....	61,350	2,154					8,867,914	266,651
Crabs, hard.....							152,000	1,809
Sea crawfish or spiny lobster.....							23,503	1,174
Clams, hard.....	2,400	600					2,400	600
Oysters, market:								
Public.....	31,500	2,250	4,900	455	153,132	7,119	313,425	15,134
Private.....							415,565	4,994
Turtles.....			600	30			6,850	402
Conch meat.....							7,000	700
Total.....	182,707	10,158	5,398,110	264,513	1,725,557	78,874	81,211,188	1,746,175

1 156,000 in number.

2 300 bushels.

3 44,775 bushels.

4 20,795 bushels.

FISHERIES BY APPARATUS.

Gill nets were the most productive form of apparatus employed in the fisheries of the east coast of Florida in 1918, the catch amounting to 11,636,930 pounds, valued at \$671,599. The principal species taken with this form of apparatus were: Mullet, 6,882,403 pounds, valued at \$275,395; Spanish mackerel, 2,301,590 pounds, valued at \$166,592; shad, 591,719 pounds, valued at \$87,789; squeteague or "sea trout," 1,030,347 pounds, valued at \$86,549; and bluefish, 374,340 pounds, valued at \$36,156. Purse seines, taking mostly menhaden, mullet, and Spanish mackerel, yielded 51,446,435 pounds.

valued at \$332,812. Other leading forms of apparatus, in the order of their importance, based on the value of their catch, were: Otter trawls with 8,967,918 pounds, principally shrimp, valued at \$268,651; haul seines with 5,699,060 pounds, valued at \$254,635; and lines with 2,914,917 pounds, valued at \$192,880.

The total yield of all forms of apparatus employed in the fisheries of the east coast of Florida amounted to 81,211,488 pounds, valued at \$1,746,175, of which 63.04 per cent of the quantity and 18.63 per cent of the value are credited to purse seines operated in the vessel fisheries, the remainder being credited to the various forms of apparatus employed in the shore fisheries.

The products of the vessel and shore fisheries of the east coast of Florida in 1918 are shown in the following tables, by counties, apparatus, and species:

YIELD OF VESSEL FISHERIES OF EAST COAST OF FLORIDA IN 1918, BY PURSE SEINES, COUNTIES, AND SPECIES.

Species.	Dade.		Duval.		Nassau.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Bluefish.....	23,564	\$1,835					23,564	\$1,835
Bluerunner or hard-tail.....	900	34					900	34
Butterfish.....	4,200	170					4,200	170
Menhaden.....			42,645,400	\$181,201	5,690,000	\$28,300	48,295,400	209,501
Mullet.....	2,242,485	74,051					2,242,485	74,051
Pompano.....	86	14					86	14
Sharks.....			50,000	250			50,000	250
Spanish mackerel.....	579,800	39,456					579,800	39,456
Total.....	2,851,035	115,561	42,685,400	181,451	5,660,000	28,300	51,196,435	325,312

YIELD OF SHORE FISHERIES OF THE EAST COAST OF FLORIDA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES.

BY SEINES.

Species.	Broward.		Duval.		Lake.		Palm Beach.		Polk.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Alewives.....					30,000	\$450			334,526	\$5,015
Angelfish.....							400	\$12		
Barracuda.....							100	8		
Black drum.....	160	\$4	2,400	\$120			21,500	430		
Bluefish.....	300	60	100	15			64,340	6,534		
Blue runner or hardtail.....							25,175	775		
Bonito.....							2,190	66		
Catfish.....							1,600	32		
Cero or kingfish.....							18,000	1,080		
Crevalle.....	800	80					43,800	1,465		
Croaker.....							21,850	655		
Flournders.....			400	40			230	7		
Grunts.....	200	20					7,390	261		
Hogfish.....							100	5		
Jewfish.....							1,450	43		
King whiting.....			8,000	800			7,936	291		
Ladyfish.....							1,280	13		
Menhaden.....							57,000	570		
Moonfish.....	100	8					1,475	46		
Mullet.....	500	50	16,000	1,280			1727,891	26,368		
Parrotfish.....							3,500	70		
Permit.....	50	5					4,130	142		
Pigfish.....							3,800	114		
Finfish or "sailor's choice".....	200	20					31,310	949		
Pompano.....	30	6	240	36			41,427	6,004		
Porkfish.....							100	3		
Redfish or red drum.....			2,400	240			21,285	682		

YIELD OF SHORE FISHERIES OF THE EAST COAST OF FLORIDA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES—Continued.
BY SEINES—Continued.

Species.	Broward.		Duval.		Lake.		Palm Beach.		Putnam.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Sea gar or needle-fish.....							100	\$5		
Sergeantfish or snook.....	150	\$12					59,376	1,871		
Shad.....					4,880	\$678	5,100	102	191,610	\$23,882
Sharks.....							9,715	298		
Sheepshead.....										
Snapper:										
Mangrove.....	300	30					1,920	59		
Mutton.....	600	60					47,680	1,430		
Spanish mackerel.....							166,122	10,683		
Spot.....			1,200	\$96			22,800	692		
Squeteague or "sea trout".....			8,000	800			29,761	2,530		
Yellowtail or "silver perch".....							19,020	571		
Sea crawfish or spiny lobster.....							652	33		
Turtles.....							250	12		
Total.....	3,390	359	38,740	3,427	34,850	1,128	1,471,785	65,806	520,136	28,870

Species.	Seminole.		St. Lucie.		St. John.		Volusia.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Alewives.....			1,470	\$44			327,739	\$4,905	692,265	\$10,373
Angelfish.....			50	1					1,870	56
Barracuda.....									150	4
Black drum.....			406,292	8,388	7,120	\$214	9,600	480	447,072	9,640
Bluefish.....			46,610	4,629	150	15	650	65	112,150	11,618
Blue runner or hardtail.....			650	13					27,825	788
Bonito.....									2,190	66
Catfish.....			12,300	246					13,900	278
Cero or kingfish.....									18,000	1,080
Crevalla.....			250,300	7,457					294,930	9,002
Croaker.....			87,740	2,332	1,250	50			110,840	3,637
Flounders.....			2,980	140					3,610	187
Grunts.....			78,889	2,365					86,479	2,646
Hogfish.....									100	5
Jewfish.....			5,150	134					6,600	177
King whiting.....			78,360	4,480	1,850	111	51,300	4,617	147,446	10,299
Ladyfish.....									1,280	13
Menhaden.....			10,200	104					67,200	674
Morish.....			100	3					1,675	57
Mullet.....			527,400	18,785			960	48	1,272,751	40,531
Parrotfish.....									3,500	70
Permit.....			460	11	115	5	200	10	4,955	173
Pigfish.....			5,400	162	150	6			9,350	282
Pinfish or "gail-or's choice".....			349,610	10,095	500	23			381,709	11,087
Pompano.....			57,435	8,615	625	94	4,000	400	103,757	15,755
Porkfish.....									100	3
Redfish or red drum.....			247,824	7,052	6,200	310	4,000	240	281,709	8,524
Sea gar or needle-fish.....									100	5
Sergeantfish or snook.....			221,065	5,637					280,591	7,520
Shad.....	102,161	\$13,277					73,266	10,248	371,887	48,055
Sharks.....			425	4					5,525	106
Sheepshead.....			58,475	2,059	210	13	200	12	68,600	2,382
Snapper:										
Mangrove.....			825	26					3,045	115
Mutton.....			137,263	3,953					185,573	5,443
Spanish mackerel.....			6,973	627					173,065	11,510
Spot.....			325,920	9,776	1,346	54	1,960	98	353,220	10,716
Squeteague or "sea trout".....			314,105	27,563	8,342	665	12,000	1,200	372,208	32,758
Yellowtail or "silver perch".....			23,290	654					42,310	1,225
Sea crawfish or spiny lobster.....									652	33
Turtles.....			600	30					850	42
Total.....	102,161	13,277	3,258,191	125,385	27,932	1,560	485,875	22,323	5,949,060	262,135

¹ Includes 250,000 pounds of mullet, valued at \$7,500, caught with purse seines.

YIELD OF SHORE FISHERIES OF THE EAST COAST OF FLORIDA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES—Continued.
BY GILL NETS.

Species.	Brevard.		Dade.		Duval.		Nassau.		Palm Beach.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Angelfish.									770	\$25
Barracuda.									2,235	67
Black drum.	36,500	\$1,095							2,450	73
Bluefish.									249,302	24,836
Blue runner or hardtail.			1,200	\$36					22,175	685
Bonito.									4,191	125
Crevalle.	3,300	132	600	18					11,975	350
Croaker.									12,558	376
Flounders.	1,210	48							100	3
Grunts.									5,290	130
King whiting.	13,900	1,132							5,275	238
Moonfish.			500	15					5,755	172
Mullet.	4,292,660	171,704	408,600	15,344	50,000	\$2,620			288,843	11,098
Permit.									2,335	71
Pigfish.	2,000	64							1,132	34
Pinfish or sailer's choice.	43,150	1,386							2,525	85
Pompano.	100	15							18,622	2,948
Porgies.									100	3
Porkfish.									1,260	37
Red drum.	31,400	1,256							10,270	453
Sea bass.									700	35
Sergeantfish or snook.	430	15							7,341	221
Shad.					265,608	36,855	61,250	\$18,000		
Sharks.									7,750	155
Sheepshead.	11,945	478							3,890	162
Snapper:										
Mangrove.	260	8							10,485	419
Mutton.	1,400	54							35,420	1,027
Spanish mackerel.			289,835	20,288					1,322,007	91,093
Spot.	20,500	675							8,240	247
Squeteague or "sea trout".	518,400	12,252							67,198	6,149
Yellowtail or "silver perch".									1,210	36
Sea crawfish or spiny lobster.									1,443	71
Total.	4,977,035	220,314	700,735	36,701	315,608	39,475	61,250	18,000	2,110,867	141,448

Species.	Putnam.		St. Lucie.		St. John.		Volusia.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Angelfish.			100	\$3					1,870	\$28
Barracuda.									2,235	67
Black drum.			900	20	8,000	\$240	4,600	\$138	52,450	1,566
Bluefish.			125,038	11,306	100	12			374,340	36,156
Blue runner or hardtail.									23,375	701
Bonito.									4,191	125
Crevalle.			3,920	117					19,795	636
Croaker.					200	6			12,738	382
Flounders.							800	32	2,110	65
Grunts.			5,130	194					10,060	333
King whiting.			4,437	375	1,300	65	650	51	25,562	1,465
Moonfish.									6,255	187
Mullet.			896,470	35,750	3,890	190	942,000	37,680	6,882,403	275,393
Permit.									2,335	71
Pigfish.			1,230	37	150	8	800	24	6,312	165
Pinfish or sailer's choice.			9,660	309	210	8	4,400	132	60,245	1,920
Pompano.			10,314	1,057	200	30			29,130	4,090
Porgies.									100	3
Porkfish.									1,260	37
Red drum.			12,050	430	1,800	73	5,400	192	60,950	2,404
Sea bass.									700	35
Sergeantfish or snook.			11,855	345					19,628	581
Shad.	261,800	\$32,934							501,719	\$7,789
Shark.									7,750	155
Sheepshead.			2,082	66	175	11	300	12	18,302	729
Snapper:										
Mangrove.			2,666	80					13,551	507
Mutton.			800	29					35,620	1,104
Spanish mackerel.			693,718	55,211					2,801,690	168,592
Spot.			5,220	162	1,600	64	3,600	108	39,160	1,216
Squeteague or "sea trout".			333,120	30,183	7,320	505	84,000	7,400	1,080,347	86,569
Yellowtail or "silver perch".									1,210	36
Sea crawfish or spiny lobster.									1,443	71
Total.	284,861	32,984	2,145,649	155,674	24,975	1,219	1,046,650	45,832	11,635,930	671,596

YIELD OF SHORE FISHERIES OF THE EAST COAST OF FLORIDA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY LINES.

Species.	Brevard.		Broward.		Dade.		Duval.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Amberfish.....			150	\$12	200	\$8		
Angelfish.....					175	7		
Barracuda.....			150	12	200	8		
Black drum.....							30,000	\$900
Bluefish.....					360	30	1,500	150
Blue runner or hardtail.....					400	12		
Bonito.....			100	10	50	3		
Cero or kingfish.....			300	45	973,331	68,133		
Cowfish and "shellfish".....					50	2		
Crevalle.....					200	8		
Grouper.....			200	20	41,978	2,518		
Grunts.....			200	20	10,650	426		
Hogfish.....					150	6		
King whiting.....							24,000	1,440
Leather jacket or "turbot".....					200	8		
Moonfish.....					40	1		
Pigfish.....					100	4		
Pinfish or sailor's choice.....					200	10		
Pompano.....					360	54		
Porgies.....					5,000	300		
Porkfish.....					350	17		
Red drum.....			100	12			21,000	1,440
Sea bass.....					100	8	20,000	1,600
Sergeantfish or snook.....			200	16				
Sheepshead.....			50	5	100	6	14,000	840
Snapper:								
Mangrove.....			300	30	2,700	135		
Mutton.....			100	10	7,500	300		
Red.....							19,200	1,920
Spanish mackerel.....					780	62		
Squeteague or "sea trout".....	75,682	\$8,039			1,000	80	80,000	6,400
Yellowtail or "silver perch".....					450	18		
Crabs, hard.....							32,000	800
Total.....	75,682	8,039	1,850	192	1,046,564	72,164	244,700	15,490

Species.	Palm Beach.		St. John.		Volusia.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Amberfish.....	11,336	\$370					11,686	\$390
Angelfish.....							175	7
Barracuda.....	180	6					530	26
Black drum.....			1,300	\$52			31,390	952
Bluefish.....	48,797	4,860	650	65			51,247	5,105
Blue runner or hardtail.....	250	7					650	19
Bonito.....	1,460	44	150	9			1,760	66
Cero or kingfish.....	1,280,161	78,350					2,233,792	146,528
Cowfish and "shellfish".....							50	2
Crevalle.....	6,105	197					6,305	205
Flounders.....	100	5	170	10			270	15
Grouper.....	32,605	1,084					74,783	3,622
Grunts.....	5,840	175	150	9			16,840	630
Hogfish.....							150	6
Jewfish.....	5,667	179	220	9			5,887	188
King whiting.....							21,000	1,440
Leather jacket or "turbot".....	170	5					370	13
Moonfish.....							40	1
Pigfish.....							100	4
Pinfish or sailor's choice.....							200	10
Pompano.....	80	16					440	70
Porgies.....	830	25					5,850	325
Porkfish.....							350	17
Red drum.....	800	32	1,200	48			26,100	1,532
Sea bass.....	19,121	980	1,110	70			40,631	2,664
Sergeantfish or snook.....	14,557	512					14,557	528
Sharks.....	500	15					500	15
Sheepshead.....	3,081	148					17,241	999
Snapper:								
Mangrove.....	3,790	188					6,790	353
Mutton.....	12,285	337					19,885	847
Red.....	1,000	80					20,200	2,000
Spanish mackerel.....	5,190	514	1,510	151			7,480	727
Squeteague or "sea trout".....	38,876	3,888	9,390	749	40,000	\$3,600	242,318	22,756
Yellowtail or "silver perch".....							450	18
Crabs, hard.....							32,000	800
Total.....	1,492,601	92,223	16,120	1,172	40,000	3,600	2,914,917	192,880

YIELD OF SHORE FISHERIES OF THE EAST COAST OF FLORIDA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY OTTER TRAWLS, CAST NETS, DIP NETS, TRAPS, AND SPEARS.

Apparatus and species.	Dade.		Duval.		Nassau.		St. John.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Otter trawls:										
Shrimp.....					8,805,568	\$394,197	61,350	\$2,454	8,867,918	\$396,651
King whiting.....					100,000	2,000			100,000	2,000
Total.....					8,905,568	396,197	61,350	2,454	8,967,918	398,651
Cast nets:										
Croaker.....							700	28	700	28
Black drum.....							510	20	510	20
Mullet.....			12,000	\$840			8,250	350	20,250	1,170
Pinfish, or sailor's choice.....							300	16	300	16
Sheepshead.....							80	5	80	5
Spot.....							650	20	650	26
Squeteague or "sea trout".....							350	28	350	28
Total.....			12,000	840			10,930	453	22,930	1,263
Dip nets: Sea crawfish or spiny lobster.....	21,408	\$1,070							21,408	1,070
Traps: Crabs, hard.....			20,000	1,000					20,000	1,000
Spears: Flounders.....							7,500	459	7,500	459

BY RAKES, TONGS, AND HAND.

Apparatus and species.	Dade.		Duval.		Nassau.		Palm Beach.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Tongs: Oysters, market, public.....			31,500	\$1,800			2,100	\$195
By hand:								
Oysters, market, public.....					90,293	\$3,315		
Oysters, market, private.....					135,065	8,994	10,500	1,000
Conch meat.....							7,000	200
Turtles.....	6,000	\$300						
Total.....	6,000	300			225,358	7,309	17,500	1,200
Apparatus and species.	St. Lucie.		St. John.		Volusia.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Rakes: Clams, hard.....			2,400	\$600			2,400	\$600
Tongs: Oysters, market, public.....	4,900	\$453	31,500	2,250	153,132	\$7,119	223,132	\$11,879
By hand:								
Oysters, market, public.....							90,293	\$3,315
Oysters, market, private.....							145,565	8,994
Conch meat.....							7,000	200
Turtles.....							6,000	300
Total.....							215,888	\$11,369

¹ Part of these were taken by gaffs.

INDUSTRIES.

Menhaden industry.—In 1918 there were 4 factories, valued at \$413,098, operated on the east coast of Florida, using \$40,000 in cash capital and employing 177 persons, to whom \$103,256 were paid in wages. The manufactured products, including the products of a factory in Georgia, follow: Oil, 125,478 gallons, valued at \$48,189; dried scrap, 444 tons, valued at \$37,296; acidulated scrap, 6,886

tons, valued at \$296,174; and crude or green scrap, 5,000 tons, valued at \$185,000.

Wholesale trade.—There were 50 firms engaged in the wholesale trade in fishery products, valued at \$534,644. These used \$101,600 in cash capital and gave employment to 416 persons, to whom \$189,421 were paid in wages.

Canning industry.—In 1918 there were 3 canneries, valued at \$92,023, using cash capital to the amount of \$15,000 and employing 275 persons, to whom \$34,306 were paid in wages. The products prepared consisted of canned oysters to the value of \$17,210, and canned shrimp to the value of \$118,660.

The following tables contain detailed statistics of these industries in 1918:

INDUSTRIES ON THE EAST COAST OF FLORIDA, 1918.

MENHADEN INDUSTRY.

Item.	Number.	Value.	Item.	Number.	Value.
Establishments.....	4	\$413,098	PRODUCTS.		
Cash capital.....		40,000	Oil.....gallons..	¹ 125,478	\$48,189
Persons engaged.....	177		Dry scrap.....tons..	444	37,296
Wages paid.....		103,256	Acidulated scrap.....do....	6,886	296,174
			Crude or green scrap...do....	¹ 5,000	185,000

OYSTER AND SHRIMP CANNING INDUSTRY.

Establishments.....	3	\$92,023	PRODUCTS—continued.		
Cash capital.....		15,000	Shrimp, canned:		
Persons engaged.....	275		No. 1 cans.....cases..	² 15,317	\$75,920
Wages paid.....		34,306	No. 1½ cans.....do....	² 8,503	42,740
PRODUCTS.			Total.....		118,660
Oysters, canned:					
4-ounce cans.....cases..	² 700	2,700			
5-ounce cans.....do....	² 1,134	8,030			
8-ounce cans.....do....	² 1,200	6,480			
Total.....		17,210			

¹ Includes one factory in Georgia.

² Four dozen cans per case.

³ Two dozen cans per case.

SUMMARY OF THE FISHERIES OF FLORIDA IN 1918.

In the following table the fisheries of both coasts of Florida are combined for purposes of comparison and study of the State as a whole with other States of the region. In 1918 the fisheries of the State gave employment to 8,491 persons, the total investment amounted to \$4,614,924, and the products amounted to 135,965,127 pounds, valued at \$5,166,538. Of the South Atlantic and Gulf States, Florida ranks first in the number of persons engaged, investment, and quantity and value of products, and North Carolina second. Louisiana ranks third, excepting in quantity of products, Georgia and Texas having larger quantities accredited to them.

FISHERIES OF FLORIDA IN 1918.

Item.	East coast.		West coast.		Total.	
PERSONS ENGAGED.	Number.	Value.	Number.	Value.	Number.	Value.
On vessels fishing.....	349		623		1,003	
On vessels transporting.....	15		70		85	
In shore fisheries.....	2,104		3,669		5,704	
Shoresmen.....	831		868		1,699	
Total.....	3,339		5,161		8,491	
INVESTMENT.						
Vessels fishing:						
Gasoline.....	23	\$377,600	33	\$92,630	56	\$470,230
Tonnage.....	725		360		1,085	
Outfit.....		71,287		27,043		98,330
Sail.....			62	309,800	62	309,800
Tonnage.....			2,069		2,069	
Outfit.....				71,520		71,520
Vessels transporting:						
Gasoline.....	7	32,300	34	105,800	41	138,100
Tonnage.....	89		435		544	
Outfit.....		3,850		22,444		26,294
Sail.....			50	80,650	50	80,650
Tonnage.....			1,025		1,025	
Boats:						
Sail, row, etc.....	637	20,180	2,019	128,500	2,626	149,080
Power.....	839	459,650	1,018	138,962	1,857	898,612
Apparatus, vessel fisheries:						
Seines.....	25	52,900	1	1,600	26	54,500
Gill nets.....			6	120	6	120
Lines.....				5,379		5,379
Otter trawls.....			16	720	16	720
Tongs.....			12	120	12	120
Sponge apparatus.....				210		210
Other apparatus.....				2		2
Apparatus, shore fisheries:						
Seines.....	117	61,030	163	61,175	280	122,205
Trammel nets.....			146	11,990	146	11,990
Gill nets.....	715	101,725	1,795	106,070	2,510	207,795
Stop nets.....			126	6,810	126	6,810
Cast nets.....	16	80			16	80
Lines.....		2,965		2,046		5,011
Otter trawls.....	255	16,500	107	4,770	362	21,270
Tongs, grabs, and rakes.....	37	224	284	2,616	321	2,840
Spears or gigs.....	12	12			12	12
Crab traps and drags.....	20	50			20	50
Sponge apparatus.....				70,935		70,935
Other apparatus.....		6		12,596		12,602
Shore and accessory property.....		538,720		619,987		1,478,707
Cash capital.....		151,699		219,350		370,950
Total.....		2,210,679		2,404,245		4,614,924
PRODUCTS.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Alewives.....	692,265	\$10,373			692,265	\$10,373
Amberfish.....	11,686	390	11,009	\$413	22,785	803
Angelfish.....	2,915	91	20,825	798	23,740	889
Barracuda.....	2,915	97	4,890	232	7,775	329
Bluefish:						
Fresh.....	561,301	54,715	246,168	17,411	807,469	72,126
Salted.....			12,240	915	12,240	915
Blue runner or hardtail:						
Fresh.....	50,750	1,542	324,648	6,955	375,398	8,477
Salted.....			65,430	2,734	65,430	2,734
Bonito.....	8,111	258	50,955	2,045	59,066	2,303
Butterfish.....	4,209	170			4,209	170
Catfish.....	13,500	278	51,427	3,126	65,527	3,494
Cero and king fish.....	2,271,792	147,608	465,860	31,903	2,737,652	179,511
Cowfish and "shellfish".....	50	2	309	12	350	14
Creville.....	321,650	9,883	105,927	3,800	426,957	13,683
Croaker.....	124,278	3,447			124,278	3,447
Drum, red and black.....	900,091	24,638	994,910	39,803	1,895,001	64,441
Elops or ten-pounder:						
Fresh.....			267,940	5,402	267,940	5,402
Salted.....			9,883	334	9,883	334
Flounders.....	13,490	737	37,381	2,080	50,871	2,816
Grouper.....	74,783	3,622	5,626,329	222,215	5,701,112	225,837
Grunts.....	113,679	3,629	87,349	3,618	201,028	7,247
Hogfish.....	250	11	7,344	336	7,594	347
Jewfish.....	12,487	365	69,844	2,794	82,331	3,059
King whiting.....	297,008	15,604	35,188	2,126	332,196	17,730

FISHERIES OF FLORIDA IN 1911.—(Continued.)

Item.	East coast.		West coast.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
PRODUCTS—continued.						
Ladyfish.....	1,280	\$13	.....	.....	1,280	\$13
Leather jacket or "turbot".....	370	13	7,756	\$337	8,126	350
Menhaden:						
Fresh.....	48,302,600	210,175	263,530	6,779	48,566,130	216,954
Salted.....	.....	.....	21,022	669	21,022	669
Moonfish.....	7,070	245	650	23	8,620	268
Mullet:						
Fresh.....	10,417,889	397,147	22,569,736	973,129	32,987,625	1,370,276
Salted.....	.....	.....	2,453,330	177,974	2,453,330	177,974
Mullet roe, salted.....	.....	.....	86,285	17,593	86,285	17,593
Parrotfish.....	5,589	70	.....	.....	5,589	70
Permit.....	7,260	214	7,865	294	15,125	508
Pinfish.....	14,762	451	6,596	250	21,358	701
Pinfish or sailor's choice.....	442,535	13,033	21,132	809	463,667	13,842
Pompano:						
Fresh.....	133,419	19,889	225,992	27,262	359,411	47,151
Salted.....	.....	.....	3,075	529	3,075	529
Porbees.....	5,950	325	59,742	2,442	65,692	2,767
Portfish.....	1,710	57	2,400	144	4,110	201
Redfish or red drum, salted.....	.....	.....	7,321	366	7,321	366
Scamp.....	.....	.....	300	10	300	10
Sea baze.....	41,331	2,699	31,644	2,180	72,975	4,879
Sea gar or needlefish.....	100	5	.....	.....	100	5
Seecaunfish or snook.....	314,774	8,629	73,745	2,568	388,519	11,197
Snail.....	963,606	135,844	.....	.....	963,606	135,844
Sharks.....	63,775	526	.....	.....	63,775	526
Sheepshead.....	104,303	4,115	988,662	32,627	1,092,965	36,742
Skipper:						
Mangrove.....	23,186	975	103,999	4,350	127,185	5,324
Mutton.....	241,078	7,399	14,100	564	255,178	7,963
Red.....	20,200	2,000	7,230,168	455,640	7,250,368	457,640
Spanish mackerel:						
Fresh.....	3,061,965	218,085	3,408,701	244,026	6,470,666	462,111
Salted.....	.....	.....	27,200	1,505	27,200	1,505
Spr.	393,030	11,998	37,977	1,519	431,007	13,517
Squeteague or "sea trout":						
Fresh.....	1,645,223	142,091	1,630,686	145,534	3,275,909	287,625
Salted.....	.....	.....	31,625	3,772	31,625	3,772
Surgeon.....	.....	.....	4,915	620	4,915	620
Surgeon caviar and roe.....	.....	.....	12	12	12	12
Tang.....	.....	.....	609	30	609	30
Tarpon.....	.....	.....	1,800	180	1,800	180
Yellowtail.....	.....	.....	31,735	1,537	31,735	1,537
Yellowtail or "silver perch".....	43,970	1,279	.....	.....	43,970	1,279
Whiting.....	8,867,918	266,651	3,250,468	81,408	12,118,386	348,059
Sea crawfish.....	23,503	1,174	322,015	16,064	345,518	17,238
Crabs:						
Hard.....	52,000	1,800	.....	.....	52,000	1,800
Stone.....	.....	.....	24,600	2,600	24,600	2,600
Terrapin.....	.....	.....	2,475	206	2,475	206
Turtles.....	6,850	402	65,370	4,429	72,220	4,831
Clams, hard.....	2,400	600	160,872	13,336	163,272	14,936
Conch meat.....	7,000	700	2,000	100	9,000	800
Oysters, market:						
Public.....	313,425	15,134	2,602,446	121,649	2,915,871	136,783
Private.....	145,565	4,994	13,496	771	159,061	5,765
Sponges:						
Glove.....	.....	.....	2,022	245	2,022	245
Grass.....	.....	.....	73,033	12,125	73,033	12,125
Sheepswool.....	.....	.....	276,168	675,781	276,168	675,781
Wire.....	.....	.....	9,324	2,817	9,324	2,817
Yellow.....	.....	.....	91,641	34,187	91,641	34,187
Total.....	81,211,388	1,716,175	54,753,639	3,123,363	135,965,027	5,166,538

¹ 156,000 in number.² 20,499 bushels.³ 416,533 bushels.⁴ 22,723 bushels.

SPONGE FISHERY OF FLORIDA.

The sponge fishery of Florida is prosecuted on the west coast of the State, and the catch is sold by bunches chiefly through the sponge exchange at Tarpon Springs. The large wool and grass sponges are estimated at $2\frac{1}{2}$ pounds per bunch, small wool sponges at 1 pound, and yellow and wire sponges at $1\frac{1}{2}$ pounds. In 1919 the quantity sold at the exchange amounted to 424,075 pounds, valued at \$707,964,

and in 1920 to 409,746 pounds, valued at \$678,209. A considerable quantity is also sold at Key West.

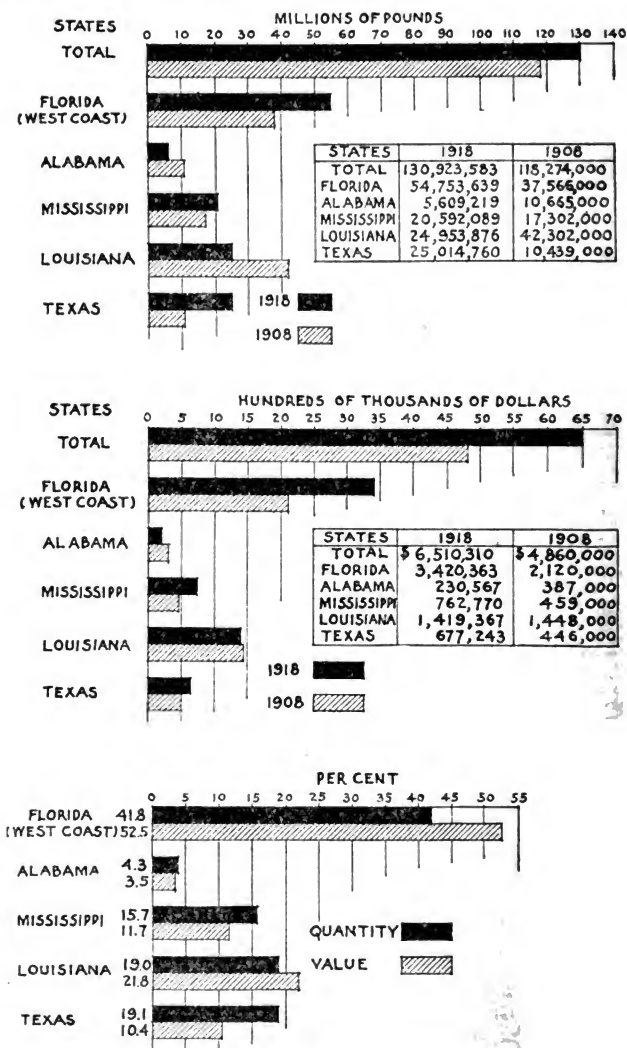


FIG. 8.—Top: Quantities of fish taken in the commercial fisheries of the Gulf States in 1918 compared with 1908. Center: Values of fish taken in the commercial fisheries of the Gulf States in 1918 compared with 1908. Bottom: Percentages of total quantity and value of fishery products for each of the Gulf States in 1918.

Following are statistics of the quantity in pounds based on the above conversion figures of the different kinds of sponges sold at the exchange at Tarpon Springs in 1919 and 1920:

SPONGES SOLD AT THE EXCHANGE, TARPON SPRINGS, FLA., 1919 AND 1920.

Kind.	1919		1920	
	Pounds.	Value.	Pounds.	Value.
Large wool.....	205,462	\$544,222	176,722	\$522,399
Small wool.....	76,309	95,386	60,902	79,172
Yellow.....	73,051	39,161	72,648	43,499
Grass.....	62,547	25,171	92,880	29,722
Wire.....	6,706	4,024	6,594	3,417
Total.....	424,075	707,964	409,746	678,209

SUMMARIES OF THE FISHERIES OF THE GULF STATES FOR VARIOUS YEARS.

In the appended table are given comparative statistics showing the number of persons engaged, investment, and quantities and values of the products of the fisheries of the Gulf States for various years from 1880 to 1918. A similar summary of the fisheries of the South Atlantic States for the same years appears on page 65 of this report. In view of the increasing attention which the fisheries of these regions are receiving, these will serve to indicate the relative rate of growth and development of these fisheries.

EXTENT OF FISHERIES OF THE GULF STATES, VARIOUS YEARS, 1880 TO 1918.¹

Item.	1880	1887	1888	1889
PERSONS ENGAGED.				
Florida (west coast).....	2,112	(²)	3,066	3,739
Alabama.....	635	(²)	318	594
Mississippi.....	186	1,153	1,390	1,909
Louisiana.....	1,597	3,607	3,738	5,966
Texas.....	691	1,027	1,021	1,211
Total.....	5,131	(²)	9,543	11,319
INVESTMENT.				
Florida (west coast).....	\$362,563	(²)	\$613,736	\$1,281,190
Alabama.....	38,200	(²)	61,904	126,925
Mississippi.....	8,800	\$284,760	329,632	455,360
Louisiana.....	93,621	633,007	664,927	708,567
Texas.....	42,400	206,591	214,511	226,431
Total.....	545,584	(²)	1,884,710	2,826,403
PRODUCTS. ³				
Pounds:				
Florida (west coast).....	8,376,335	(²)	(²)	23,597,240
Alabama.....	3,541,500	(²)	1,633,589	4,560,209
Mississippi.....	788,590	6,548,175	7,833,010	8,933,339
Louisiana.....	6,990,000	18,455,489	19,121,056	29,947,239
Texas.....	3,858,875	6,282,489	6,609,161	7,357,800
Total.....	23,561,210	(²)	(²)	65,395,887
Value:				
Florida (west coast).....	\$564,819	(²)	\$628,396	\$948,845
Alabama.....	119,275	(²)	75,560	145,841
Mississippi.....	22,540	\$189,716	231,712	259,884
Louisiana.....	392,610	579,504	612,820	621,408
Texas.....	128,300	256,250	271,257	297,258
Total.....	1,227,544	(²)	1,819,745	2,264,876

¹ Statistics for 1908 are from data published by the Bureau of the Census.

² Statistics not available.

³ The quantity and value of products given for Florida for 1888 in the report of the Division of Statistics and Methods of the Fisheries for 1919, page 137, include both coasts of the State, and those for Alabama for 1908 include the Tennessee River district.

EXTENT OF FISHERIES OF THE GULF STATES, VARIOUS YEARS, 1880 TO 1918—Contd.

Item.	1890	1897	1902	1908	1918
PERSONS ENGAGED.					
Florida (west coast).....	4,068	5,011	6,416	6,016	5,161
Alabama.....	618	789	1,098	805	783
Mississippi.....	1,721	2,565	4,344	1,561	2,867
Louisiana.....	4,068	4,403	5,027	5,152	4,191
Texas.....	1,277	1,139	1,144	1,780	1,886
Total.....	11,752	13,967	18,029	15,404	14,888
INVESTMENT.					
Florida (west coast).....	\$1,369,294	\$1,149,262	\$1,945,320	\$1,884,000	\$2,401,245
Alabama.....	135,290	165,180	328,285	262,000	331,741
Mississippi.....	434,710	518,301	1,270,408	461,000	1,432,585
Louisiana.....	719,876	513,813	789,723	841,000	1,475,188
Texas.....	319,122	237,496	375,724	454,000	880,100
Total.....	2,978,292	2,584,061	4,707,460	3,902,000	6,537,859
PRODUCTS.²					
Pounds:					
Florida (west coast).....	27,418,562	28,255,219	48,120,019	37,566,000	54,753,639
Alabama.....	4,776,968	4,699,381	9,351,447	9,918,450	5,609,219
Mississippi.....	8,131,401	7,829,185	23,439,965	17,302,000	20,592,080
Louisiana.....	20,789,203	17,401,788	24,754,135	42,302,000	24,953,876
Texas.....	7,959,400	7,174,550	8,044,404	10,439,000	25,014,760
Total.....	69,075,534	65,360,623	113,669,970	117,527,450	130,923,583
Value:					
Florida (west coast).....	\$1,064,139	\$944,793	\$1,462,166	\$2,129,000	\$3,420,363
Alabama.....	154,871	134,438	266,682	358,000	280,567
Mississippi.....	245,699	192,298	553,220	459,000	762,770
Louisiana.....	960,134	713,587	858,514	1,448,000	1,419,367
Texas.....	313,832	286,610	353,814	446,000	677,243
Total.....	2,438,675	2,271,726	3,494,496	4,831,600	6,510,310

¹ Exclusive of persons and investment in canneries, packing houses, and other establishments.

² The quantity and value of products given for Florida for 1888 in the report of the Division of Statistics and Methods of the Fisheries for 1919, page 137, include both coasts of the State, and those for Alabama for 1908 include the Tennessee River district.

FISHERIES OF THE NEW ENGLAND STATES IN 1919.

The statistics of the coast fisheries of the New England States presented in this report are for the calendar year 1919 and have been published in summarized form in Statistical Bulletin No. 497.¹¹

Included in this report are statistics of the sardine industry of Maine for 1919 and 1920 and the salmon fishery of the Penobscot River and Bay for 1918, 1919, and 1920.

EARLIER PUBLICATIONS.

Some of the previous publications containing statistical information on the fisheries of the New England States and published in Washington, D. C., follow:

1873. Report on the Conditions of the Sea Fisheries of the South Coast of New England in 1871 and 1872. By Spencer F. Baird. Report, U. S. Commission of Fish and Fisheries, 1871 and 1872 (1873), p. i-xli.
1887. The Coast of Maine and Its Fisheries. By R. Edward Earll. In *The Fisheries and Fishery Industries of the United States*, by G. Brown Goode et al., Sec. II, Pt. I, p. 5-102.
- The Fisheries of New Hampshire. By W. A. Wilcox. *Ibid.*, Sec. II, Pt. II, p. 103-112.

¹¹ The statistical data were collected by Winthrop A. Roberts, Rob Leon Greer, Andrew J. Messner, Walter H. Rich, Lawrence T. Hopkinson, and Fred F. Johnson, statistical agents of the Bureau.

1887. The Fisheries of Massachusetts. By A. Howard Clark. Ibid., Sec. II, Pt. III, p. 113-280.
 The Fisheries of Rhode Island. By A. Howard Clark. Ibid., Sec. II, Pt. IV, p. 281-310.
 The Coast of Connecticut and Its Fisheries. By A. Howard Clark. Ibid., Sec. V, p. 311-340.
 History and Methods of the Fisheries. Ibid., Sec. V, Vol. I (xi+50 p.), Vol. II (xx+881 p.), and atlas of 275 pls.
1889. The Sea Fisheries of Eastern North America. By Spencer F. Baird. Appendix A, Report, U. S. Commission of Fish and Fisheries, 1886 (1889), 224 p.
1891. Notes on the Oyster Fishery of Connecticut. By J. W. Collins. Bulletin, U. S. Fish Commission, Vol. IX, 1889 (1891), p. 461-497, Pl. CLIX-CLXVI.
1892. III. Fisheries of the New England States [1887 and 1888]. In Statistical Review of the Coast Fisheries of the United States, prepared under the direction of J. W. Collins. Report, U. S. Commission of Fish and Fisheries, 1888 (1892), p. 286-322.
 Report on the Fisheries of the New England States. By J. W. Collins and Hugh M. Smith. Bulletin, U. S. Fish Commission, Vol. X, 1890 (1892), p. 73-176.
1898. The Herring Industry of the Passamaquoddy Region, Maine. By Ansley Hall. Report, U. S. Commission of Fish and Fisheries, 1896 (1898), p. 443-487.
1899. The Shad Fisheries of the Atlantic Coast of the United States. By Charles H. Stevenson. Report, U. S. Commission of Fish and Fisheries, 1898 (1899), p. 101-269.
1901. The Lobster Fishery of Maine. By John N. Cobb. Bulletin, U. S. Fish Commission, Vol. XIX, 1899 (1901), p. 241-265, illus., pl. 28-32.
 Statistics of the Fisheries of the New England States. Report, U. S. Commission of Fish and Fisheries, 1900 (1901), p. 311-386.
1905. Statistics of the Fisheries of the New England States, 1902. Report, U. S. Bureau of Fisheries, 1904 (1905), p. 245-325.
1908. Statistics of the Fisheries of the New England States for 1905. Report and Special Papers, U. S. Bureau of Fisheries, 1906 (1908), 93 p.
1911. Fisheries of the United States, 1908. Special Reports, Bureau of the Census, 1911.

COMMON AND SCIENTIFIC NAMES OF FISHES.

Following is a list of the common and scientific names of the fishes of New England States to which reference is made in the present report. If the trade will adopt the common names employed herein, it is believed that much of the confusion now encountered will be avoided and that in this way the consumer may be educated to the relative merits of individual species.

Alewives.....	{ <i>Pomolobus astivalis</i> .
Bluefish.....	{ <i>Pomolobus pseudoharengus</i> .
Bonito.....	<i>Pomatomus saltatrix</i> .
Bullhead.....	<i>Sar ta sarda</i> .
Butterfish.....	<i>Ameiurus nebulosus</i> .
Carp.....	<i>Foronotus triacanthus</i> .
Cod.....	<i>Cyprinus carpio</i> .
Cunner.....	<i>Gadus celleries</i> .
Cusk.....	<i>Tautoglabrus adspersus</i> .
Eels.....	<i>Brosnius brosme</i> .
Flounders.....	{ <i>Anguilla rostrata</i> .
Grayfish.....	{ <i>Leptocephalus conger</i> .
Haddock.....	<i>Pleuronectidae (species)</i> .
Hake.....	<i>Squalus acanthias</i> .
Halibut.....	<i>Melanogrammus aeglefinus</i> .
Herring.....	{ <i>Urophycis tenuis</i> .
Hickory shad.....	{ <i>Urophycis chus</i> .
King whiting.....	<i>Hippoglossus hippoglossus</i> .
	<i>Clupea harengus</i> .
	<i>Pomolobus mediacris</i> .
	<i>Menticirrhus saxatilis</i> .

Launce.....	<i>Ammodytes americanus</i> .
Mackerel.....	<i>Scomber scombrus</i> .
Menhaden.....	<i>Brevoortia tyrannus</i> .
Monkfish.....	<i>Lophius piscatorius</i> .
Minnows.....	Various species small fishes.
Perch, white.....	<i>Morone americana</i> .
Perch, yellow.....	<i>Perca flavescens</i> .
Pickrel.....	<i>Esox reticulatus</i> .
Pollock.....	<i>Pollockius virens</i> .
Pompano.....	<i>Trachinotus (species)</i> .
Rosefish.....	<i>Sebastes marinus</i> .
Round herring.....	<i>Etruncus teres</i> .
Salmon, Atlantic.....	<i>Salmo salar</i> .
Salmon, humpback.....	<i>Oncorhynchus gorbuscha</i> .
Sculpins.....	Cottidae (species).
Scup.....	<i>Stenotomus chrysops</i> .
Sea bass.....	<i>Centropristes striatus</i> .
Sea robin.....	<i>Prionotus carolinus</i> .
Shad.....	<i>Prionotus strigatus</i> .
Sharks.....	<i>Alosa sapidissima</i> .
Skates and rays.....	All Selachii except Batoidei.
Smelt.....	Batoidei (species).
Squeteague.....	<i>Osmerus mordax</i> .
Striped bass.....	<i>Cynoscion regalis</i> .
Sturgeon.....	<i>Roccus lineatus</i> .
Suckers.....	<i>Acipenser sturio</i> .
Sunfish.....	Catostomidae (species).
Swordfish.....	Centrarchidae (species).
Tautog.....	<i>Xiphias gladius</i> .
Tilefish.....	<i>Tautoga onitis</i> .
Tomcod.....	<i>Lopholatilus chamaeleonticeps</i> .
Tuna.....	<i>Microgadus tomcod</i> .
Whiting.....	<i>Thunnus thynnus</i> .
Wolfish.....	<i>Mertuccius bilinearis</i> .
	<i>Anarhichas lupus</i> .

GENERAL STATISTICS.

The fisheries of the New England States in 1919 gave employment to 30,767 persons, of whom 6,346 were on vessels fishing, 533 on vessels transporting fishery products, 10,968 in the shore or boat fisheries, and 12,920 shoresmen in the wholesale fishery trade, canneries, smokehouses, oysterhouses, and other shore industries connected with the fisheries. The number of persons engaged in the fisheries of the different States follows: Maine, 14,386; Massachusetts, 12,346; Connecticut, 2,289; Rhode Island, 1,646; and New Hampshire, 100. Compared with the returns for 1905, the year for which the last canvass was made by the Bureau, there has been a decrease in the number of persons employed in all of the States of 6,572 persons, or 17.60 per cent. The decrease by States follows: Massachusetts, 3,348 persons, or 21.33 per cent; Maine, 1,495 persons, or 9.41 per cent; Connecticut, 1,118 persons, or 32.81 per cent; Rhode Island, 566 persons, or 25.59 per cent; and New Hampshire, 45 persons, or 31.03 per cent.

The total amount of capital invested in the fisheries and fishery industries of these States in 1919 was \$40,597,097. There has been an increase of \$18,066,377, or 80.18 per cent, in money invested in the fisheries and fishery industries of the region since 1905. In Maine the investment amounted to \$17,544,969, an increase of \$8,572,920, or 95.55 per cent, as compared with 1905. In Massachusetts the investment was \$19,111,269, an increase of \$8,300,827,

or 76.79 per cent, compared with 1905. In Rhode Island the investment amounted to \$2,249,536, an increase of \$1,184,110, or 111.14 per cent. In Connecticut the investment was \$1,645,793, an increase of \$10,040, or 0.61 per cent, as compared with 1905; and in New Hampshire the investment in 1919 was \$45,530, a decrease of \$1,520, or 3.23 per cent, as compared with 1905. The investment included 757 fishing vessels, valued at \$8,501,081, having a net tonnage of 24,099 tons and outfits valued at \$2,400,500; 221 transporting vessels, valued at \$741,005, having a net tonnage of 3,214 tons and outfits valued at \$185,425; 10,364 boats, valued at \$2,280,713; fishing apparatus used by vessels and boats, valued at \$2,888,332; shore and accessory property to the value of \$20,354,089; and cash or working capital to the amount of \$3,245,952. The principal forms of fishing apparatus arranged in order of value are pound nets, trap nets, and weirs, 1,119 in number, valued at \$1,087,997; lobster pots, 239,558, valued at \$612,207; seines, 441, valued at \$415,507; gill nets, 14,616, valued at \$324,246; and lines valued at \$287,579.

The use of the otter trawl introduced in the vessel and shore fisheries for the capture of ground fish probably represents the most important change in apparatus since 1905. In 1905 none were reported in operation, while in 1919 there were 492, valued at \$37,987.

The combined catch of all the New England States amounted to 467,339,870 pounds, valued at \$19,838,657. Of this amount the largest quantity, amounting to 246,951,241 pounds, valued at \$10,859,746, is credited to Massachusetts. Maine ranks second, with a catch of 147,956,369 pounds, valued at \$3,889,035; Rhode Island third, with a catch of 48,250,883 pounds, valued at \$3,296,578; Connecticut fourth, with 23,652,647 pounds, valued at \$1,700,638; and New Hampshire fifth, with 528,730 pounds, valued at \$92,660.

The more important species taken in these States were: Cod, 84,917,535 pounds, valued at \$3,597,891; oysters, 19,337,374 pounds, or 2,762,482 bushels, valued at \$2,617,020; lobsters, 10,666,706 pounds, valued at \$2,550,980; haddock, 89,405,609 pounds, valued at \$2,544,617; and mackerel, 15,785,012 pounds, valued at \$1,562,088.

Compared with the Bureau's returns for 1905 there has been a decrease in the products of the fisheries of 12,943,734 pounds, or 2.70 per cent, in the quantity, and an increase of \$5,654,452, or 39.87 per cent, in the value. Compared with the returns of the Bureau of the Census for 1908 there has been a decrease in the products of 62,689,130 pounds, or 11.83 per cent, in the quantity and an increase of \$4,699,657, or 31.04 per cent, in the value. Compared with 1905 there was an increase in the quantity of products in Maine amounting to 23,232,583 pounds, or 18.62 per cent; in Rhode Island, of 24,354,640 pounds, or 101.92 per cent; but decreases in Connecticut of 51,320,001 pounds, or 68.45 per cent; in Massachusetts, of 8,703,234 pounds, or 3.40 per cent, and in New Hampshire of 507,722 pounds, or 48.99 per cent. In 1919 there was an increase in the value of the products in all of the States except Connecticut, as compared with 1905, as follows: Massachusetts, \$3,834,497, or 54.56 per cent; Rhode Island, \$1,749,920, or 113.14 per cent; Maine, \$1,502,629, or 62.96 per cent; and New Hampshire, \$40,716, or 78.38 per cent. In Connecticut the decrease in value amounted to \$1,473,310, or 46.42 per cent.

The following table gives the catch of certain species for various years from 1889 to 1919. These have been subdivided into groups

along the following general lines: (a) Species for which there have been relatively intensive fisheries and which on the basis of the returns reveal little indication of depletion of supply; (b) species showing signs of a depleted supply; and (c) species for which there has been an increasing demand and a sufficient supply to satisfy that demand.

PRODUCTS, IN POUNDS, OF CERTAIN FISHERIES OF THE NEW ENGLAND STATES.
VARIOUS YEARS, 1889 TO 1919.

Year.	Cod.	Hake.	Mackerel.	Swordfish.	Clams, hard.
1889.	97,145,645	14,816,366	8,361,408	1,229,339	711,266
1898.	89,207,975	37,184,193	8,795,084	1,617,331	794,222
1902.	88,254,949	35,152,559	20,358,682	1,680,740	1,233,520
1905.	75,065,224	35,470,667	15,981,024	3,226,369	1,768,264
1908.	95,284,000	34,121,300	11,492,000	2,703,000	1,881,000
1919.	84,917,535	20,222,267	15,785,012	1,325,980	1,082,132

Year.	Halibut.	Alewives.	Shad.	Lobster.	Clams, soft.
1889.	10,740,843	7,882,682	1,331,714	30,449,603	11,542,272
1898.	10,528,187	6,985,948	1,415,649	14,661,808	11,288,901
1902.	12,365,705	8,437,116	1,380,812	14,756,495	8,345,491
1905.	3,017,776	8,745,284	1,260,904	11,524,469	6,878,550
1908.	4,353,500	7,581,000	1,285,500	14,734,000	7,294,000
1919.	1,960,030	3,782,283	939,995	10,666,707	4,962,574

Year.	Haddock.	Pollock.	Herring.	Whiting.	Flounders.
1889.	43,473,627	8,442,397	36,316,259	126,080	2,950,958
1898.	45,676,153	9,444,887	64,587,461	41,050	4,102,694
1902.	47,077,315	17,744,127	191,739,467	2,513,470	4,808,146
1905.	76,617,156	28,949,359	83,330,554	4,812,840	5,761,453
1908.	59,544,000	29,244,300	121,700,000	713,000	9,753,000
1919.	89,405,609	25,009,639	97,636,395	16,199,637	13,541,647

The following tables contain statistics of the number of persons employed, the amount of capital invested, the quantity and value of the products of the fisheries of the New England States in 1919, statistics of certain shellfish products in bushels and number, and comparative statistics of persons, investment, and products for various years from 1880 to 1919:

FISHERIES OF THE NEW ENGLAND STATES, 1919.

Item.	Maine.		New Hampshire.		Massachusetts.	
	Number.	Value.	Number.	Value.	Number.	Value.
PERSONS ENGAGED.						
On vessels fishing	1,094				4,459	
On vessels transporting	339		3		65	
In shore fisheries	5,332		85		3,757	
Shoresmen	7,711		12		4,084	
Total	14,386		109		12,346	
INVESTMENT.						
Vessels, fishing:						
Steam	5	\$1,002,500			34	\$4,484,500
Tonnage	662				3,310	
Outfit		70,050				329,561
Gasoline	173	511,650			208	2,775,500
Tonnage	2,039				8,262	
Outfit		91,073				1,069,438
Sail	4	55,000			54	808,313
Tonnage	392				4,734	
Outfit		25,500				332,312

FISHERIES OF THE NEW ENGLAND STATES. 1919—Continued.

Item.	Maine.		New Hampshire.		Massachusetts.	
INVESTMENT—continued.						
Vessels transporting:	Number.	Value.	Number.	Value.	Number.	Value.
Steam.....	2	\$9,000				
Tonnage.....	28					
Outfit.....		2,800				
Gasoline.....	165	510,040		\$5,500	22	\$108,950
Tonnage.....	1,762		8		460	
Outfit.....		103,998		3,660		16,080
Sail.....	2	16,715			3	13,800
Tonnage.....	121				132	
Outfit.....		6,375				2,375
Boats:						
Sail, row, etc.....	2,759	83,629	31	802	1,308	58,488
Power.....	3,060	902,080	53	10,675	1,732	891,185
Apparatus, vessel fisheries:						
Selnes.....	84	93,270			100	193,850
Gill nets.....	1,253	29,689			5,430	107,685
Otter trawls.....	13	2,520			119	17,850
Lines, hand and trawl.....		34,747				133,658
Harpoons.....		2,230				6,455
Lobster pots.....	1,085	2,195			430	1,060
Dredges.....	4	190			224	2,516
Tongs and rakes.....					3	49
Whaling apparatus.....						23,030
Apparatus, shore fisheries:						
Selnes.....	103	41,055			67	46,045
Gill nets.....	2,746	71,214			3,688	77,323
Pound nets, trap nets, and weirs.....	690	514,065			251	387,470
Fyke nets.....	146	3,685			53	1,585
Bag nets and pocket nets.....	95	8,675				
Bow nets.....					13	36
Dip nets and scoop nets.....	102	776			104	374
Otter trawls.....	39	1,635			191	9,510
Lines, hand and trawl.....		61,410		462		51,412
Harpoons.....		215				540
Spears.....	42	57			72	171
Cunner traps.....	80	110			4	6
Eel pots and traps.....	599	1,358	18	36	1,826	4,455
Lobster pots.....	153,532	382,258	2,275	6,735	43,012	109,359
Crabs traps.....	180	340				
Dredges.....	24	2,500			2,764	16,521
Tongs and grabs.....					235	1,355
Rakes.....			2	12	784	5,656
Forks and hoes.....	1,103	1,167	25	50	475	887
Cockle traps.....					680	500
Shore and accessory property.....		11,864,571		11,758		7,000,239
Cash capital.....		1,020,707		5,500		1,902,945
Total.....		17,541,909		15,530		13,111,269
PRODUCTS.						
Alwolves:	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Fresh.....	590,811	\$7,455			1,697,476	\$24,070
Salted.....	6,860	176			1,259,134	55,995
Smoked.....	352,293	19,606			39,060	2,845
Bluefish.....	29	7				791
Bonito.....	44	4			189,727	18,016
Butterfish.....	32,763	3,031			206,828	26,810
Cod:						
Fresh.....	13,095,145	479,827	98,354	\$3,600	69,320,920	2,826,091
Salted.....	983,241	62,312			3,175,405	166,702
Canner.....	30,695	615			9,959	585
Cusk:						
Fresh.....	1,046,147	33,580	2,400	86	1,561,237	55,068
Salted.....					16,570	750
Eels.....	3915,050	25,249	2,600	240	371,167	47,714
Flounders.....	469,594	22,227	8,000	240	10,252,693	478,850
Grayfish.....					63,667	184
Goosefish or monkfish.....					2,500	7
Haddock:						
Fresh.....	11,124,411	332,215	18,764	829	77,804,810	2,191,215
Salted.....	73,400	2,812			373,574	16,906
Hake:						
Fresh.....	16,108,575	329,227	3,000	98	4,066,437	156,353
Salted.....	5,000	256			29,095	1,307
Halibut:						
Fresh.....	217,476	31,841			1,708,509	296,232
Salted.....	1,000	80			8,043	1,060
Herring:						
Fresh.....	86,646,126	455,604			10,811,409	129,408
Salted.....	6,200	187				
Smoked.....	161,350	6,715				

FISHERIES OF THE NEW ENGLAND STATES, 1919—Continued.

Item.	Maine.		New Hampshire.		Massachusetts.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
PRODUCTS—continued.						
Hickory shad.....					12,809	889
King whiting.....					72	15
Launce.....					67,800	509
Mackarel:						
Fresh.....	593,506	\$81,428			12,267,122	1,212,461
Salted.....	8,000	650			1,249,092	109,948
Frigate.....					61,361	1,862
Menhaden.....					161,219	2,231
Minnows.....					1,000	125
Perch:						
White.....					6,200	991
Yellow.....					500	25
Pollock:						
Fresh.....	5,597,163	113,487	25,600	\$615	19,192,388	468,169
Salted.....	34,800	2,440			50,153	1,774
Pompano.....					14	2
Rosefish.....	17,322	245			36,773	1,121
Round herring.....					941	19
Salmon:						
Atlantic.....	20,610	7,926				
Humpback.....	310	62				
Sculpin.....					6,000	15
Scup.....					78,624	5,666
Sea bass.....					15,067	1,649
Sea robin.....					400	1
Shad.....	414,455	28,393			62,337	4,809
Sharks.....	39,747	884			328,269	3,664
Skates and rays.....	2,385	47			100,354	703
Smelt.....	523,967	94,400			39,150	10,690
Squeteague.....					5,777	908
Striped bass.....	592	113			5,971	231
Sturgeon.....	8,129	1,714			12,068	3,338
Sturgeon caviar.....					150	376
Sturgeon roe.....	143	267			181	365
Sneakers.....	110,400	11,852				
Swordfish.....	424,813	104,734			711,729	163,390
Tautog.....	14	2			91,876	5,387
Tilefish.....					188,180	9,363
Tomcod.....	147,160	4,511			7,890	229
Tuna.....	31,909	2,040			42,901	3,548
Whiting:						
Fresh.....	684,970	4,727			13,918,630	148,854
Salted.....	3,000	60				
Wolfish.....	83,958	2,061			201,188	9,219
Other fish.....					38,232	4,117
Lobster.....	5,545,884	1,411,548	298,012	73,203	2,387,696	616,393
Shrimp.....					3,400	1,889
Crabs:						
Hard.....	70,575	3,595			1,764,961	49,424
Soft.....					296	40
Squid.....	377	4			6,134,557	108,864
Clams:						
Hard—						
Public.....					853,304	27,342
Private.....					22,640	12,425
Soft—						
Public.....	2,105,734	163,209	66,601	13,320	2,062,630	232,194
Private.....					125,000	10,750
Razor.....					23,300	3,500
Oysters:						
Market—						
Public.....					5,579	1,393
Private.....					769,055	278,164
Seed—						
Public.....					23,100	1,320
Private.....					80,178	6,382
Scallops.....	72,512	31,416			1,332,486	139,852
Mussels.....	16,970	367				
Cockles and winkles.....					577,400	8,425
Blackfish.....					40,000	40
Porpoise.....					750	15
Livers.....	112,587	1,712			313,675	4,444
Spawn.....	15,857	778			146,929	8,536
Tongues and cheeks.....	5,200	190			600	12
Sounds.....	5,212	96				
Oil:						
Sperm.....					1,545,413	218,111
Liver.....	8,625	895				
Ambergris.....					30	3,000
Alewife scales.....					10,400	5,219
Irish moss.....			6,000	420	204,200	15,027
Total.....	147,956,369	3,889,035	528,730	92,660	246,951,241	16,859,746

FISHERIES OF THE NEW ENGLAND STATES, 1919—Continued.

Item.	Rhode Island.		Connecticut.		Total.	
	Number.	Value.	Number.	Value.	Number.	Value.
PERSONS ENGAGED.						
On vessels fishing	317		569		6,346	
On vessels transporting	44		81		533	
In shore fisheries	795		1,019		10,968	
Shoremen	490		623		12,920	
Total	1,646		2,289		30,767	
INVESTMENT.						
Vessels, fishing:						
Steam	9	\$141,000	24	\$328,243	72	\$3,956,288
Tonnage	564		2,210		6,776	
Outfit		51,910		135,346		687,267
Gasoline	55	199,400	67	180,425	603	3,670,983
Tonnage	849		924		12,014	
Outfit		82,025		94,690		1,327,166
Sail			24	12,495	82	873,810
Tonnage			153		5,309	
Outfit				7,955		389,067
Vessels transporting:						
Steam	5	22,000	2	13,200	9	44,200
Tonnage	77		111		216	
Outfit		23,800		9,627		36,227
Gasoline	13	29,200	4	7,800	205	692,290
Tonnage	104		95		2,429	
Outfit		10,500		4,370		138,548
Sail					5	39,515
Tonnage					253	
Outfit				4,000		8,750
Boats			2		2	4,000
Tonnage			316		316	
Outfit				1,900		1,900
Sail, row, etc.	196	4,503	399	9,670	4,603	157,102
Power	432	182,780	364	136,881	5,671	2,123,611
Apparatus, vessel fisheries:						
Seines	18	24,695	4	7,800	206	319,615
Gill nets	780	14,445	115	2,689	7,578	154,499
Pound nets	25	75,000			25	75,000
Other trawls	20	973	14	680	166	22,023
Lines, hand and trawl		785		555		169,745
Harpoons		561		600		10,046
Lobster pots	635	1,985	480	745	2,639	5,975
Dredges	48	2,092	372	8,437	648	13,445
Tongs and rakes					3	49
Whaling apparatus						29,000
Apparatus, shore fisheries:						
Seines	11	809	54	4,893	235	95,892
Gill nets	360	7,300	204	13,910	7,038	169,747
Pound nets, trap nets, and twines	108	101,750	42	9,112	1,094	1,012,997
Fyke nets	290	5,218	429	3,985	928	14,473
Bag nets and pocket nets					95	8,675
Bow nets					13	36
Dip nets and scoop nets	30	450	7	35	243	1,635
Other trawls	43	2,423	53	2,394	326	15,964
Lines, hand and trawl		4,492		58		117,534
Harpoons		690		80		1,525
Spears			50	39		267
Cunner traps					84	146
Eel pots and traps	965	1,035	801	617	1,239	7,341
Lobster pots	21,096	65,346	16,173	42,534	236,928	696,232
Crab traps					180	330
Dredges	201	1,119	55	305	3,044	20,535
Tongs and grabs	247	1,999	244	1,991	726	5,348
Rakes	29	166	61	367	876	6,201
Forks and hoes	152	148	68	69	1,823	2,821
Shovels	43	43	13	13	56	56
Cockle traps					680	500
Winkle pots	260	880			260	880
Shore and accessory property		978,622		498,699		20,354,089
Cash capital		209,390		98,500		3,245,952
Total		2,249,536		1,645,793		40,597,097

FISHERIES OF THE NEW ENGLAND STATES, 1919—Continued.

Item.	Rhode Island.		Connecticut.		Total.	
PRODUCTS.						
Alewives:	<i>Pounds.</i>	<i>Value.</i>	<i>Pounds.</i>	<i>Value.</i>	<i>Pounds.</i>	<i>Value.</i>
Fresh.....	269,565	\$5,915	177,150	\$6,637	2,125,002	\$63,078
Salted.....					1,265,991	59,171
Smoked.....					391,293	22,151
Bluefish.....	25,675	3,170	3,710	386	34,145	4,351
Bonito.....	114,810	10,825	6,120	912	510,701	29,759
Bullheads.....			1,492	100	1,492	100
Butterfish.....	758,845	39,188	18,810	2,607	1,107,246	71,636
Carp.....			40,141	4,922	40,141	4,922
Cod:						
Fresh.....	1,148,331	49,747	95,136	9,603	80,758,886	3,368,877
Salted.....					4,158,649	229,014
Cunner.....	8,000	960			48,654	2,160
Cusk:						
Fresh.....			6,767	73	2,616,651	88,807
Salted.....					16,870	750
Eels.....	274,755	29,637	63,046	9,839	1,018,998	112,679
Flounders.....	2,451,579	79,567	2,349,181	91,962	15,541,047	672,840
Grayfish.....					63,667	184
Goosefish or monkfish.....					2,500	7
Haddock:						
Fresh.....	10,300	512	350	38	88,958,635	2,524,809
Salted.....					446,974	19,808
Hake:						
Fresh.....			10,100	102	20,188,112	485,780
Salted.....					31,155	1,563
Halibut:						
Fresh.....			25,000	5,000	1,950,985	333,073
Salted.....					9,045	1,140
Herring:						
Fresh.....	169,660	4,010	3,000	71	97,630,195	589,060
Salted.....					6,200	187
Smoked.....					161,550	6,715
Hickory shad.....					12,800	830
King whiting.....					72	18
Lance.....					67,800	888
Mackerel:						
Fresh.....	1,575,923	146,611	91,389	10,900	14,527,550	1,451,490
Salted.....					1,257,062	110,508
Frigate.....					61,361	1,862
Menhaden.....	21,536,000	268,700	6,736,564	93,312	28,433,783	361,243
Minnows.....					1,000	125
Perch:						
White.....	5,043	702			11,243	1,622
Yellow.....			6,108	505	6,608	620
Pickarel.....			1,079	143	1,079	143
Pollock:						
Fresh.....	99,400	5,920	10,135	717	24,924,686	588,908
Salted.....					84,953	4,214
Pompano.....					14	2
Rosefish.....					54,085	1,369
Round herring.....					941	19
Salmon:						
Atlantic.....	70	12			20,680	7,938
Humpback.....					310	62
Sculpin.....					6,000	15
Scup.....	8,261,140	807,846	1,980	202	8,341,744	823,714
Sea bass.....	52,041	5,954	5,555	528	70,663	8,131
Sea robin.....					400	1
Shad.....			45,203	86,637	939,995	119,339
Sharks.....					368,146	4,548
Skates and rays.....			400	10	103,139	560
Smelt.....			25,217	4,466	588,334	109,652
Squeteague.....	335,860	33,829	21,076	3,257	382,713	37,994
Striped bass.....	33,705	5,236	4,810	1,059	40,078	6,639
Sturgeon.....			25	5	20,252	5,077
Sturgeon caviar.....					150	356
Sturgeon roe.....					324	460
Suckers.....			99,653	7,488	209,453	19,340
Sunfish.....			105	11	105	11
Swordfish.....	101,010	19,757	88,428	15,006	1,325,980	294,827
Tautog.....	371,660	22,191	21,942	2,068	485,492	33,146
Tilefish.....					188,180	9,803
Tomcod.....			455	37	155,505	4,787
Tuna.....	61,350	4,810	5,114	550	141,274	10,948
Whiting:						
Fresh.....	1,583,700	16,910	9,317	175	16,196,637	169,766
Salted.....					3,000	90
Wolfish.....					375,146	11,280
Other fish.....					38,232	2,117
Lobster.....	1,694,327	360,679	749,818	189,157	10,696,707	2,350,980

FISHERIES OF THE NEW ENGLAND STATES, 1919—Continued.

Item.	Rhode Island.		Connecticut.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
PRODUCTS—continued.						
Shrimp.....					3,400	\$1,580
Crabs:						
Hard.....	31,330	\$1,852			1,839,696	54,821
Soft.....					263	40
Squid.....	377,579	18,759	3,612	\$258	6,516,125	127,855
Clams:						
Hard—						
Public.....	156,232	59,649	49,976	18,912	1,039,512	349,003
Private.....					22,640	12,425
Soft.....						
Public.....	403,760	24,075	229,150	32,070	4,867,874	454,898
Private.....					125,000	19,750
Razor.....					23,300	3,500
Oysters:						
Market—						
Public.....			136,654	21,900	142,233	23,283
Private.....	6,261,759	1,242,585	4,925,668	471,766	11,857,482	1,992,515
Seed—						
Public.....			740,516	68,349	763,616	69,699
Private.....			6,493,865	525,001	6,571,043	531,553
Scallops.....	33,494	11,608			1,477,392	499,123
Mussels.....	10,000	1,000	38,400	13,717	25,970	1,367
Cockles and winkles.....	10,500	2,100			587,500	5,525
Blackfish.....					40,000	40
Porpoise.....						15
Livers.....					426,162	6,550
Spawn.....					165,786	9,614
Tongues and cheeks.....					5,880	292
Sorrels.....					5,212	96
Oil:						
Sperm.....					1,545,413	218,111
Liver.....					8,625	895
Ambergris.....					30	5,000
Alewife scales.....					10,400	5,200
Irish moss.....	2,000	240			212,200	15,687
Total.....	48,250,883	3,290,378	23,652,647	1,700,638	467,339,879	19,838,657

CERTAIN OF THE FOREGOING SHELLFISH PRODUCTS IN BUSHELS AND NUMBER.

Products.	Maine.		New Hampshire.		Massachusetts.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Clams:						
Hard (quahogs)—						
Public..... bushels.....					106,663	\$271,342
Private..... do.....					2,830	12,425
Soft.....						
Public..... do.....	210,573	\$163,209	6,699	\$13,320	206,263	232,194
Private..... do.....					12,500	10,750
Razor..... do.....					2,330	3,500
Oysters:						
Market—						
Public..... do.....					797	1,383
Private..... do.....					176,865	278,161
Seed—						
Public..... do.....					3,300	1,320
Private..... do.....					11,454	6,552
Scallops..... do.....	12,685	31,416			222,081	439,382
Mussels..... do.....	1,697	367				
Cockles..... do.....					57,740	3,425
Crabs:						
Hard..... number.....	211,725	3,565			5,294,883	49,424
Soft..... do.....					798	40

CERTAIN OF THE FOREGOING SHELLFISH PRODUCTS IN BUSHELS AND NUMBER—
Continued.

Products.	Rhode Island.		Connecticut.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Clams:						
Hard (quahogs)—						
Public.....bushels..	19,529	\$39,649	6,247	\$18,912	132,439	\$349,908
Private.....do.....					2,830	12,425
Soft—						
Public.....do.....	40,373	24,075	22,915	32,070	486,787	464,868
Private.....do.....					12,500	10,750
Razor.....do.....					2,330	3,500
Oysters:						
Market—						
Public.....do.....			19,522	21,900	20,319	23,283
Private.....do.....	894,537	1,242,385	689,524	471,766	1,693,926	1,992,513
Seed—						
Public.....do.....			105,788	68,349	109,088	69,669
Private.....do.....			927,695	525,001	939,149	531,553
Scallops.....do.....	5,696	14,608	6,400	13,717	246,232	199,123
Mussels.....do.....	1,000	1,000			2,697	1,367
Cockles.....do.....					57,749	3,425
Winkles.....do.....	1,050	2,100			1,050	2,100
Crabs:						
Hard.....number.....					5,506,608	53,019
Soft.....do.....					798	40

EXTENT OF FISHERIES OF NEW ENGLAND STATES, VARIOUS YEARS, 1880 TO 1919.¹

Item.	1880	1887	1888	1889
PERSONS ENGAGED.				
Maine.....	11,071	15,323	15,171	14,129
New Hampshire.....	414	346	362	365
Massachusetts.....	20,117	17,053	17,037	17,238
Rhode Island.....	2,310	1,635	1,708	1,787
Connecticut.....	3,131	3,024	3,037	3,047
Total.....	37,043	37,381	37,310	36,566
INVESTMENT.				
Maine.....	\$3,341,341	\$3,179,233	\$3,023,921	\$2,889,800
New Hampshire.....	209,465	166,110	167,144	112,660
Massachusetts.....	14,334,450	13,205,050	13,110,765	13,245,229
Rhode Island.....	596,678	992,761	1,022,876	1,020,128
Connecticut.....	1,421,020	2,807,687	2,869,314	2,836,894
Total.....	19,902,957	20,380,841	20,134,020	19,094,794
PRODUCTS				
Pounds:				
Maine.....		131,379,591	132,929,504	129,559,864
New Hampshire.....		4,254,727	3,843,479	4,354,568
Massachusetts.....		269,544,343	302,045,680	292,217,699
Rhode Island.....		45,284,872	91,687,487	127,965,475
Connecticut.....		39,750,008	42,401,612	92,672,464
Total.....		520,213,541	572,907,858	633,170,090
Value:				
Maine.....	\$2,742,571	\$2,364,906	\$2,292,043	\$2,111,290
New Hampshire.....	170,634	99,460	93,041	88,511
Massachusetts.....	7,959,760	6,464,406	6,355,495	5,858,774
Rhode Island.....	696,814	683,495	825,092	935,144
Connecticut.....	933,242	300,746	297,337	1,657,506
Total.....	12,503,021	9,913,003	9,860,011	10,550,641

¹ The statistics for 1908 are from data published by the Bureau of the Census.

EXTENT OF FISHERIES OF NEW ENGLAND STATES, VARIOUS YEARS, 1880 TO 1919—
Continued.

Item.	1898	1902	1905	1908	1919
PERSONS ENGAGED.					
Maine.....	16,954	19,872	15,881	6,801	14,386
New Hampshire.....	154	161	145	79	100
Massachusetts.....	14,363	14,300	15,664	11,577	12,346
Rhode Island.....	1,687	2,117	2,212	1,493	1,646
Connecticut.....	2,473	2,840	3,407	2,147	2,289
Total.....	35,631	39,250	37,349	22,157	30,767
INVESTMENT.					
Maine.....	\$4,013,053	\$6,939,503	\$8,972,049	\$2,411,000	\$17,544,969
New Hampshire.....	52,648	42,002	47,650	23,000	45,530
Massachusetts.....	13,372,962	10,811,594	10,810,442	5,750,000	19,111,269
Rhode Island.....	957,142	1,014,280	1,065,425	1,504,000	2,249,488
Connecticut.....	1,241,201	1,201,055	1,635,753	2,281,000	1,645,793
Total.....	19,637,006	20,008,434	22,530,720	11,969,000	40,597,049
PRODUCTS.					
Pounds:					
Maine.....	123,404,561	242,390,371	124,723,788	173,843,000	147,956,369
New Hampshire.....	3,020,715	1,593,013	1,006,452	677,000	528,730
Massachusetts.....	202,257,817	230,645,950	235,654,475	244,313,000	246,951,241
Rhode Island.....	32,854,396	21,613,961	23,806,243	44,254,000	48,250,883
Connecticut.....	31,920,417	37,832,149	74,972,648	66,942,000	23,652,647
Total.....	393,457,906	534,075,447	480,283,604	530,029,000	470,995,169
Value:					
Maine.....	\$2,654,919	\$2,918,772	\$2,386,406	\$3,257,000	\$3,889,035
New Hampshire.....	48,987	50,003	51,944	53,000	92,660
Massachusetts.....	4,463,727	6,482,427	7,025,249	7,036,000	10,850,746
Rhode Island.....	955,058	1,155,701	1,546,658	1,752,000	3,296,578
Connecticut.....	1,559,599	1,799,381	3,173,948	2,982,000	1,700,638
Total.....	9,682,290	12,406,284	14,184,205	15,139,000	19,887,406

BY-PRODUCTS.

Only a few firms are engaged solely in the preparation of by-products in the New England States and several of these are the sole manufacturers of a particular product within the State or section, the greater part of the material being prepared incidental to other branches of the fishery trade. It is therefore impracticable to present a detailed table of this important industry for individual States. In the following table the quantity and value of the products are shown as completely as possible without disclosing private enterprise.

In view of the increased demand for protein feed for hogs, cattle, and poultry, it is suggested that New England producers of scrap and pomace give consideration to the manufacture of fish waste and waste fish into fish meal for feeding purposes.

QUANTITY AND VALUE OF VARIOUS FISHERY BY-PRODUCTS PREPARED IN NEW ENGLAND IN 1919.

Item.	Maine.		Massachusetts.		Total.	
	Number.	Value.	Number.	Value.	Number.	Value.
Oil.....						
Liver.....gallons..	197,077	\$106,363	158,797	\$180,055	355,874	\$286,998
Herring.....do....	23,801	14,569			23,801	14,569
Sperm.....do....			206,655	218,111	206,655	218,111
Liquid glue.....do....	25,058	31,583	438,252	474,924	413,310	509,507
Fish scrap and meal.....pounds..	4,115,290	130,461	6,291,997	140,570	10,407,197	271,031
Drying pomace.....do....	1,271,424	16,111			1,271,424	16,111
Other products.....						333,135
Total.....		302,387		1,014,238		1,649,762

¹ Includes a small quantity made in New Hampshire.

² Of this amount, 1,150 gallons, or 8,625 pounds, valued at \$845, were produced by fishermen.

³ All produced by fishermen.

⁴ Includes a small quantity of dry glue.

⁵ Includes value of oyster shell grit made in Rhode Island and menhaden oil, dry scrap, and acidulated scrap made in Connecticut.

FISHERIES OF MAINE.

Maine ranks first among the New England States in the number of persons engaged in the fisheries and related industries, but is surpassed by Massachusetts in the amount of capital invested and the quantity and value of fishery products. In 1919 the number of persons engaged in the various branches of the fishery industry in Maine was 14,386, of whom 1,004 were on vessels fishing, 339 on vessels transporting fishery products, 5,332 in the shore or boat fisheries, and 7,711 in the wholesale fishery trade, canning sardines, and other fishery industries.

The amount of capital invested amounted to \$17,544,969, which includes 351 fishing and transporting vessels, valued at \$2,105,905, with a net tonnage of 5,004 tons and outfits valued at \$300,036; 5,849 power, sail, row, and other small boats, valued at \$985,719; fishing apparatus to the value of \$1,259,031, of which gear to the value of \$165,051 was employed in the vessel fisheries and gear to the value of \$1,093,980 on boats; shore and accessory property to the value of \$11,864,571; and cash or working capital to the amount of \$1,029,707.

The products of the fisheries amounted to 147,956,369 pounds, valued at \$3,889,035. This represents 31.65 per cent of the total quantity and 19.60 per cent of the total value of the products of the fisheries of the New England States in 1919. Compared with 1905 there was an increase of 18.62 per cent in quantity and 62.96 per cent in value to the fishermen. Compared with 1908 there was a decrease of 14.89 per cent in the quantity and an increase in the value of 19.40 per cent. Among the products of special importance were the following: Lobsters, 5,545,884 pounds, valued at \$1,411,548; cod, fresh and salted, 14,078,389 pounds, valued at \$542,139; herring, fresh, salted, and smoked, 86,813,876 pounds, valued at \$462,506; haddock, fresh and salted, 11,197,811 pounds, valued at \$335,027; and hake, fresh and salted, 16,113,635 pounds, valued at \$329,483.

FISHERIES BY COUNTIES.

Statistics as to number of persons employed, investment, and products of the fisheries of Maine in 1919 are given by counties in the following table:

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF MAINE IN 1919, BY COUNTIES.

Item.	Cumberland.		Hancock.		Kennebec.		Knox.	
	Number.	Value.	Number.	Value.	Number.	Value.	Number.	Value.
PERSONS ENGAGED.								
On vessels fishing.....	321		180				254	
On vessels transporting.....	19		64				47	
In shore fisheries.....	621		1,489		36		676	
Shoresmen.....	832		1,145				668	
Total.....	1,813		2,878		36		1,645	

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF MAINE IN 1919, BY COUNTIES—Continued.

Item.	Cumberland.		Hancock.		Kennebec.		Knox.	
INVESTMENT.								
Vessels fishing:	Number.	Value.	Number.	Value.	Number.	Value.	Number.	Value.
Steam.....	1	\$2,500					1	\$1,000,000
Tonnage.....	9						653	
Outfit.....		300						69,750
Gasoline.....	62	214,230	27	\$36,500			40	65,200
Tonnage.....	808		272				308	
Outfit.....		40,382		9,835				8,750
Sail.....			4	53,000				
Tonnage.....			392					
Outfit.....				25,800				
Vessels transporting:								
Gasoline.....	9	26,900	29	69,530			22	81,200
Tonnage.....	70		290				213	
Outfit.....		3,075		21,250				13,123
Sail.....			1	15,000				
Tonnage.....			75					
Outfit.....				6,200				
Boats:								
Power.....	488	173,325	832	286,210			522	147,900
Sail, row, etc.....	150	1,070	634	15,195	12	\$420	537	17,995
Apparatus, vessel fisheries:								
Otter trawls.....	3	90					5	2,050
Lines.....		18,112		4,343				3,545
Seines.....	35	26,320	11	12,700			15	19,300
Gill nets.....	813	22,590					30	750
Harpoons.....		1,705						25
Lobster pots.....			220	495			865	1,700
Dredges.....							4	400
Apparatus, shore fisheries:								
Pound nets, trap nets, and weirs.....	17	11,800	21	170,225			75	59,400
Lines, hand and trawl.....		13,084		25,376				8,255
Gill nets.....	1,620	29,630	213	6,245	19	550	6	120
Seines.....	42	14,130	10	10,150			20	3,200
Bag nets and pocket nets.....			15	1,025	6	450		
Fyke nets.....	1	200			81	1,483		
Dip nets.....			4	12			22	43
Lobster pots.....	20,996	41,734	38,101	96,241			28,270	55,505
Eel pots and traps.....	15	475	60	90	28	55	12	25
Otter trawls.....	189	330	1	60			5	250
Crab traps.....	80	140						
Cunner traps.....			13	15				
Spears.....								
Harpoons.....		30						
Hoes and forks.....	119	119	424	421			69	70
Dredges.....			15	1,650			9	850
Shore and accessory property.....		1,808,540		1,338,545				1,363,515
Cash capital.....		440,605		116,550				181,820
Total.....		2,954,438		2,322,718		2,800		3,108,726
PRODUCTS.								
Alatives:	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Fresh.....	4,925	\$51	134,635	\$1,628			224,200	\$184
Salted.....			63	6				
Smoked.....			39,973	3,077			109,620	6,187
Bluefish.....	39	7						
Bonito.....	41							
Butterfish.....	15,135	1,392					178	21
Catfish and wolfish.....	36,622	772	86	2			46,309	1,266
cod:								
Fresh.....	3,841,651	164,430	2,627,161	67,777			2,751,122	98,607
Salted.....			954,959	59,960			2,000	900
Cunner.....	30,605	615						
Cusk.....	564,601	20,189	113,772	1,599			72,749	1,510
Eels.....			7,050	950	7,050	\$600	1,000	100
Flounders.....	145,223	4,309	17,830	805			124,537	6,511
Haddock:								
Fresh.....	1,459,468	40,701	579,051	23,267			7,683,357	220,907
Salted.....			73,400	2,812				
Hake:								
Fresh.....	1,991,536	80,874	9,648,570	149,679			2,456,424	44,929
Salted.....			200	15			500	75

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF MAINE IN 1919, BY COUNTIES—Continued.

Item.	Cumberland.		Hancock.		Kennebec.		Knox.	
PRODUCTS—continued.								
Halibut:								
Fresh.....	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Fresh.....	38,215	\$0,507	21,087	\$3,522			72,048	\$0,918
Salted.....			1,000	80				
Herring:								
Fresh.....	3,390,072	33,763	22,178,901	122,641			9,888,575	45,009
Smoked.....							29,060	1,700
Mackerel, fresh.....	223,181	33,918	16,211	2,100			41,747	5,936
Pollock:								
Fresh.....	1,984,382	45,739	817,583	12,212			1,321,818	24,136
Salted.....			7,700	215				
Rosefish.....	15,617	219						
Salmon, Atlantic.....	961	80	7,030	2,795				
Shad.....	22,032	1,584	78,286	4,810	7,280	\$1,265	120,843	2,425
Sharks.....	27,729	622					529	15
Skates.....	2,385	47						
Smelt.....	136,202	12,345	95,435	16,470	1,350	340	93,600	17,150
Sturgeon.....	1,618	177	2,000	160			781	207
Suckers.....	3,000	240			55,300	6,540		
Swordfish.....	307,711	74,515					27,000	5,840
Tautog.....	11	2						
Tomcod.....					65,175	1,955		
Tuna.....	8,734	600						
Whiting:								
Fresh.....	610,535	4,016					11,100	61
Salted.....	3,000	90						
Squid.....	377	4						
Lobsters.....	670,050	187,904	1,394,959	346,903			1,362,219	348,850
Crabs, hard.....	70,575	3,595						
Clams, soft.....	442,659	48,151	636,135	42,416			162,675	10,376
Scallops.....			30,800	14,200			41,712	17,216
Mussels.....							16,970	867
Sound.....		13	120	1			4,200	42
Spawn.....	10,546	363					272	20
Livers.....	74,949	1,009	1,100	13			3,063	40
Total.....	16,135,178	768,836	39,485,158	882,175	136,153	10,809	26,669,546	870,229

Item.	Lincoln.		Penobscot.		Sagadahoc.		Waldo.	
PERSONS ENGAGED.								
	Number.	Value.	Number.	Value.	Number.	Value.	Number.	Value.
On vessels fishing.....	88							
On vessels transporting.....	4						8	
In shore fisheries.....	588		53		293		146	
Shoresmen.....	92		61		5		154	
Total.....	772		114		268		308	
INVESTMENT.								
Vessels fishing: Gasoline.....	17	\$82,700						
Tonnage.....	164							
Outfit.....		7,051						
Vessels transporting:								
Gasoline.....	2	4,200					8	\$18,900
Tonnage.....	16						69	
Outfit.....		1,165						2,225
Boats:								
Power.....	298	73,010	4	\$600	136	\$28,140	56	14,075
Sail, row, etc.....	410	11,440	39	1,550	162	4,800	186	10,064
Apparatus, vessel fisheries:								
Otter trawls.....	1	50						
Lines.....		1,590						
Seines.....	18	25,500						
Gill nets.....	15	400						
Apparatus, shore fisheries:								
Pound nets, trap nets, and weirs.....	25	15,050	1	100	32	22,500	103	77,315
Lines, hand and trawl.....		4,145		1,200		2,901		200
Gill nets.....	759	18,755	60	705	287	8,776		
Seines.....	18	7,550			3	500		
Bag nets and pocket nets.....	16	1,200	6	550	9	750	13	1,300
Fyke nets.....	41	1,160			23	840		
Dip nets.....	4	6						
Lobster pots.....	16,366	33,175			3,213	6,505	600	1,200

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF MAINE IN 1919, BY COUNTIES—Continued.

Item.	Lincoln.		Penobscot.		Sagadahoc.		Waldo.	
INVESTMENT—continued.								
Apparatus shore fisheries—Continued.	Number.	Value.	Number.	Value.	Number.	Value.	Number.	Value.
Eel pots and traps.....	43	\$75	30	\$60	280	\$546	55	\$115
Otter trawls.....	11	500			7	350		
Spears.....	25	30						
Harpoons.....		55				30		
Hoes and forks.....	78	90			9	17		
Shore and accessory property.....		141,640		82,600		12,710		195,216
Cash capital.....		34,530		10,000		1,500		20,000
Total.....		465,067		97,365		90,955		340,500
PRODUCTS.								
Alewives:	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Fresh.....	40,200	\$296	19,000	\$100	3,200	\$85	7,000	\$190
Salted.....	6,800	170						
Smoked.....	104,700	3,392			71,000	5,700		
Butterfish.....	800	80			16,650	1,538		
Catfish and wolfish.....	100	7						
Cod:								
Fresh.....	899,711	26,486			330,728	16,079	14,300	600
Salted.....	3,000	180						
Cusk.....	46,971	1,440			14,720	587		
Eels.....	52,000	4,060	24,000	2,400	175,650	12,525	8,000	800
Flounders.....	52,403	3,748			39,950	3,196		
Haddock, fresh.....	188,714	5,593			32,382	1,187	2,000	80
Hake, fresh.....	1,079,617	18,805			309,940	12,218	4,300	130
Halibut, fresh.....	811	122			11,040	1,750		
Herring:								
Fresh.....	5,174,117	41,658			641,400	5,011	5,479,880	22,518
Smoked.....	120,000	4,200						
Mackerel:								
Fresh.....	170,511	24,049			72,143	8,801	8,707	1,354
Salted.....	8,000	650						
Pollock, fresh.....	468,170	9,076			109,630	1,773	4,000	110
Rosefish.....	800	12						
Salmon, Atlantic.....			2,650	1,131	4,812	1,745	3,857	1,845
Shad.....	139,384	11,174	13	8	39,050	6,330	3,121	220
Sharks.....	9,644	193						
Smelt.....	53,500	13,242	1,900	475	74,230	18,811	23,450	5,862
Striped bass.....					535	101	57	12
Sturgeon.....	950	184			2,777	986		
Sturgeon roe.....					143	297		
Suckers.....	40,500	3,810			11,600	1,262		
Tomcod.....	37,160	1,116	24,000	600			15,000	375
Tuna.....	17,300	1,088			5,875	352		
Whiting, fresh.....	400	4			59,600	596		
Lobsters.....	619,886	152,327			147,664	39,739	8,800	640
Clams, soft.....	192,600	15,252			7,860	899		
Spawn.....	103	8						
Livers.....	4,375	73						
Total.....	9,443,287	342,495	71,563	5,014	2,185,599	141,588	5,582,472	34,736

Item.	Washington.		York.		Total.	
PERSONS ENGAGED.	Number.	Value.	Number.	Value.	Number.	Value.
On vessels fishing.....	58		103		1,004	
On vessels transporting.....	197				339	
In shore fisheries.....	1,263		197		5,332	
Shoemen.....	4,725		9		7,711	
Total.....	6,243		309		14,386	
INVESTMENT.						
Vessels fishing:						
Steam.....					5	\$1,002,500
Tonnage.....					662	
Outfit.....						70,050
Gasoline.....	13	\$33,500	14	\$31,500	173	514,650
Tonnage.....	176		311		2,039	
Outfit.....		11,228		13,767		91,013
Sail.....					4	53,000
Tonnage.....					392	
Outfit.....						25,800

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF MAINE IN
1919, BY COUNTIES—Continued.

Item.	Washington.		York.		Total.	
INVESTMENT—continued.						
Vessels transporting:	Number.	Value.	Number.	Value.	Number.	Value.
Steam.....	2	\$9,000			2	\$9,000
Tonnage.....	28				28	
Outfit.....		2,800				2,800
Gasoline.....	95	306,410			106	510,040
Tonnage.....	1,104				1,762	
Outfit.....		63,157				103,978
Sail.....	1	1,715			2	16,715
Tonnage.....	46				121	
Outfit.....		175				6,375
Boats:						
Power.....	613	139,945	141	\$38,875	3,000	902,080
Sail, row, etc.....	557	16,550	42	1,575	2,799	83,639
Apparatus, vessel fisheries:						
Otter trawls.....			4	330	13	2,730
Lines.....		745		6,450		34,747
Seines.....	5	9,455			84	93,270
Gill nets.....			375	5,949	1,252	23,689
Harpoons.....				500		2,250
Loobster pots.....					1,086	2,185
Dredges.....					4	400
Apparatus, shore fisherie.						
Pound nets, trap nets, and weirs.....	104	158,275			680	514,665
Lines, hand and trawl.....		4,245		2,064		61,440
Gill nets.....	65	1,573	357	4,840	2,786	71,214
Seines.....		4,760	4	3,825	103	44,035
Bag nets and pocket nets.....	3	3,400			96	8,675
Pyke nets.....					146	5,685
Dip nets.....	58	295	14	420	102	775
Loobster pots.....	38,685	126,630	7,001	21,218	153,632	382,258
Eel pots and traps.....	65	194	19	58	660	1,198
Otter trawls.....					20	1,635
Crab traps.....					180	330
Cunner traps.....					80	110
Spears.....			4	12	42	57
Harpoons.....				100		215
Hoes and forks.....	336	431	8	16	1,103	1,167
Dredges.....					24	2,500
Shore and accessory propert.		6,646,220		15,585		11,864,571
Cash capital.....		222,700		2,060		1,029,707
Total.....		7,763,336		169,004		17,544,969
PRODUCTS.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Alwelves:						
Fresh.....	147,650	\$2,321			580,811	\$7,455
Salted.....					6,860	176
Smoked.....	24,000	1,250			332,202	19,606
Bluefish.....					30	7
Bonito.....					44	4
Butterfish.....					32,763	3,631
Catfish and wolfish.....			841	\$14	83,958	2,061
Cod:						
Fresh.....	1,204,742	36,935	1,515,730	68,913	13,095,145	477,827
Salted.....	16,925	1,445	6,360	427	963,244	62,312
Cunner.....					30,695	615
Cusk.....	15,749	253	218,285	7,902	1,046,147	35,381
Eels.....	18,360	2,125	12,000	1,680	235,050	25,247
Flounder.....	9,746	251	86,911	3,377	469,094	22,227
Haddock:						
Fresh.....	142,685	5,522	1,036,774	34,958	11,124,411	332,215
Salted.....					73,465	2,812
Hake:						
Fresh.....	140,278	2,862	477,910	19,710	16,108,575	329,227
Salted.....	4,300	160			5,060	266
Halibut:						
Fresh.....	53,345	6,422	20,930	3,660	217,470	31,841
Salted.....					1,000	80
Herring:						
Fresh.....	34,893,181	185,004			50,646,126	455,604
Salted.....	6,200	187			6,220	187
Smoked.....	12,556	815			161,630	6,715
Mackerel:						
Fresh.....			1,000	5,280	593,506	80,428
Salted.....					8,000	650
Pollock:						
Fresh.....	638,680	12,657	252,880	7,784	5,567,103	113,487
Salted.....	25,100	2,095	2,000	100	34,800	2,440

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF MAINE IN 1919, BY COUNTIES—Continued.

Item.	Washington.		York.		Total.	
PRODUCTS—continued.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Rosefish.....			905	\$14	17,322	\$245
Salmon:						
Atlantic.....	1,280	\$321			20,619	7,926
Humpback.....	310	62			310	62
Shad.....	4,000	390	446	53	414,455	28,393
Sharks.....			1,845	54	39,747	884
Skates.....					2,385	47
Smelt.....	3,390	8,226	8,000	1,575	523,967	94,496
Striped bass.....					592	113
Sturgeon.....					8,129	1,714
Sturgeon roe.....					143	297
Suckers.....					110,400	11,852
Swordfish.....			90,102	24,579	421,813	104,724
Tautog.....					14	2
Tomcod.....	5,825	465			147,160	4,511
Tuna.....					31,900	2,040
Whiting:						
Fresh.....	3,337	50			681,970	4,727
Salted.....					3,000	90
Squid.....					377	4
Lobsters.....	549,306	206,425	493,000	128,700	5,545,884	1,411,548
Crabs, hard.....					170,575	3,595
Clams, soft.....	651,910	43,365	12,500	2,770	2,105,734	163,209
Scallops.....					872,512	31,416
Mussels.....					116,970	367
Tongues and cheeks.....	28	40	5,000	150	5,200	190
Soundings.....	20	40			5,212	96
Spawn.....	2	1	7,847	386	18,857	778
Layers.....	17,020	39	12,075	180	112,587	1,712
Oil, liver.....	3,736	375	4,875	520	68,626	805
Total.....	43,912,193	520,561	4,328,216	312,592	147,956,369	3,889,035

211,725 in number.
210,573 bushels.

12,085 bushels.
1,697 bushels.

1,150 gallons.

FISHERIES BY APPARATUS.

In the fisheries of Maine in 1919 pots ranked above all other forms of apparatus in the value of their catch, with 5,793,784 pounds of lobsters, valued at \$1,432,004, and 247,950 pounds of eels, valued at \$20,480. Lines ranked second with 32,992,588 pounds, valued at \$978,134, the principal species taken with lines arranged in the order of their value being: Cod, 7,432,231 pounds, valued at \$397,322; hake, 15,230,183 pounds, valued at \$309,878; and haddock, 3,857,610 pounds, valued at \$129,678. The yield of the pound net, trap net, and weir fishery amounted to 76,231,256 pounds, valued at \$452,146, of which 74,043,982 pounds, valued at \$362,339, were herring. Otter trawls taking mostly haddock, cod, and flounders, yielded 9,316,245 pounds, valued at \$296,356. Various species were taken in seines to the amount of 15,626,164 pounds, valued at \$220,530, and in gill nets to the amount of 4,283,308 pounds, valued at \$156,546. The catch with hoes and forks, consisting principally of soft clams, amounted to 2,122,704 pounds, valued at \$163,576; and that with harpoons, consisting mostly of swordfish, amounted to 452,633 pounds, valued at \$106,499. The combined catch of all forms of fishing apparatus employed in both the shore and vessel fisheries amounted to 147,956,369 pounds, valued at \$3,889,035.

The following tables show by counties, apparatus, and species the products of the vessel and shore fisheries of Maine in 1919:

YIELD OF VESSEL FISHERIES OF MAINE IN 1919, BY COUNTIES, APPARATUS, AND SPECIES.

Apparatus and species.	Cumberland.		Hancock.		Knox.		Lincoln.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Otter trawls:								
Butterfish					25	\$9		
Catfish and wolfish					45,660	1,241		
Cod					1,389,051	59,729		
Flounders	20,034	\$631			67,301	3,088	8,695	\$270
Haddock					7,001,906	196,054		
Hake					52,262	2,144		
Halibut					49,207	7,856		
Pollock					64,940	1,590		
Sharks					19	1		
Sturgeon					784	207		
Spawn					150	11		
Total	20,034	631			8,668,905	271,807	8,695	270
Lines:								
Catfish and wolfish	5,815	152	85	\$2	649	25	100	7
Cod—								
Fresh	1,384,643	59,534	285,519	6,908	505,993	17,025	60,484	2,583
Salted			951,000	59,660				
Cusk	483,865	17,310	1,816	29	21,129	562	13,986	497
Flounders	5,823	95	30	1	286	6	123	2
Haddock—								
Fresh	696,608	19,616	14,920	734	320,181	9,813	18,080	482
Salted			73,400	2,812				
Hake	839,392	34,389	108,385	1,909	853,597	15,378	138,749	3,001
Halibut—								
Fresh	34,353	5,842	3,707	556	3,596	540	11	2
Salted			1,000	80				
Pollock—								
Fresh	146,531	4,952	43,443	626	206,982	3,641	3,961	106
Salted			7,700	245				
Rosefish	14,332	199					800	12
Sharks	1,827	49			200	5	644	13
Skates	188	3						
Sounds			120	1				
Spawn	7,240	263			122	9	163	5
Livers	24,893	454			2,413	32	4,375	73
Total	3,645,510	142,849	1,491,126	73,653	1,915,118	47,036	260,366	6,886
Seines:								
Alewives	3,800	45					5,000	39
Butterfish	628	80			153	15		
Cod			1,934	83			612	26
Flounders	20	1						
Haddock							23	1
Hake			110	5				
Herring	3,167,907	31,542	776,509	7,655	1,029,975	8,244	2,827,967	25,763
Mackerel—								
Fresh	25,488	4,004	11,214	1,650	20,126	3,239	98,344	15,029
Salted							8,000	630
Pollock	139,094	3,342	283,580	4,928	725,592	12,513	85,861	1,543
Salmon, Atlantic	7	2						
Shad	9,368	695	68,286	4,140	118,343	2,229	103,330	6,440
Sharks	5,275	142			310	9		
Smelt	16,422	1,565						
Sturgeon	202	15						
Whiting	2,065	16			11,100	61	400	4
Livers	1,023	16	1,100	13	650	8		
Total	3,371,299	41,465	1,142,724	18,474	1,900,249	26,318	3,128,645	49,497
Gill nets:								
Catfish and wolfish								
Fresh	978	33						
Cusk	543,253	22,620					11,500	34
Flounders	1,620	103						
Haddock	2,660	60						
Hake	164,591	4,556					1,250	38
Halibut	37,107	1,449					950	18
Mackerel	18	2						
Pollock	46,115	6,011			12,500	1,300		
Rosefish	629,359	15,042					1,450	27
Total	55	2						

YIELD OF VESSEL FISHERIES OF MAINE IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

Apparatus and species.	Cumberland.		Hancock.		Knox.		Lincoln.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Gill nets—Continued.								
Shad.....	262	\$23						
Sharks.....	4,150	101						
Skates.....	55	2						
Sturgeon.....	400	47						
Lobsters.....	110	24						
Spawn.....	1,110	34						
Livers.....	5,906	106						
Total.....	1,434,719	50,245			12,500	\$1,500	15,130	\$428
Harpoons: Swordfish.....	305,200	73,903			27,000	5,840		
Lobster pots: Lobsters.....			14,845	\$3,750	48,125	12,053		
Dredges: Scallops.....					12,068	5,340		
Grand total.....	8,776,762	300,153	2,648,695	\$95,877	12,590,265	369,973	3,402,896	\$7,071

Apparatus and species.	Washington.		York.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Otter trawls:						
Butterfish.....					25	\$6
Catfish and wolffish.....					15,660	1,241
Cod.....					1,389,051	59,729
Flounders.....			31,000	\$1,050	127,030	5,029
Haddock.....					7,001,906	196,054
Hake.....					52,262	2,144
Halibut.....					46,207	7,876
Pollock.....			270	9	65,210	1,569
Sharks.....					19	1
Sturgeon.....					784	207
Spawn.....					150	11
Total.....			31,270	1,059	8,728,304	273,847
Lines:						
Catfish and wolffish.....			692	11	7,312	197
Cod—						
Fresh.....	270,390	\$8,278	1,045,546	44,994	3,561,575	139,422
Salted.....	500	10			951,560	59,729
Cusk.....	11,040	275	208,076	7,519	739,862	29,192
Flounders.....	240	1			6,562	105
Haddock—						
Fresh.....	18,075	688	829,952	23,236	1,897,816	54,569
Salted.....					73,400	2,812
Hake.....	17,643	651	385,286	15,797	2,343,032	71,206
Halibut—						
Fresh.....	15,180	1,985	17,890	3,039	74,697	11,964
Salted.....					1,000	80
Pollock—						
Fresh.....	42,630	701	32,550	784	476,067	10,810
Salted.....					7,700	245
Rosefish.....			905	14	10,037	225
Sharks.....			155	3	2,826	70
Skates.....					188	3
Sounds.....					120	1
Spawn.....	29	1	7,529	309	15,083	650
Livers.....	25	1	11,125	174	42,831	734
Total.....	375,752	12,641	2,539,616	95,940	10,217,548	379,005
Seines:						
Alewives.....					8,800	84
Butterfish.....					781	95
Cod.....					2,546	109
Flounders.....					20	1
Haddock.....					25	1
Hake.....					110	5
Herring.....	2,348,400	9,785			10,150,149	82,989
Mackerel—						
Fresh.....					155,172	23,922
Salted.....					8,000	650
Pollock.....	215,000	2,960			1,448,827	25,288
Salmon, Atlantic.....					7	2
Shad.....					299,333	13,504
Sharks.....					5,585	151
Smelt.....					16,422	1,565
Sturgeon.....					202	15
Whiting.....					13,565	81
Livers.....					2,773	37
Total.....	2,563,400	12,745			12,112,317	148,499

YIELD OF VESSEL FISHERIES OF MAINE IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

Apparatus and species.	Washington.		York.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Gill nets:						
Catfish and wolfish.					1,057	\$35
Cod—						
Fresh.			165,130	7,100	719,885	\$3,265
Salted.			4,360	327	4,360	327
Cusk.			1,145	42	2,765	145
Flounders.			271	7	2,961	67
Haddock.			47,226	1,137	213,047	5,721
Hake.			25,169	1,032	63,226	2,409
Halibut.					18	3
Mackerel.					58,615	7,511
Pollock.			104,960	2,628	732,769	17,687
Rosefish.					55	2
Shad.			446	53	708	76
Sharks.			690	21	4,840	132
Skates.					55	2
Sturgeon.					400	47
Loabsters.					50	24
Spawu.			318	17	1,428	51
Livers.			950	12	6,856	118
Total.			350,744	12,378	1,813,093	64,651
Harpouus: Swordfish.			83,302	24,179	421,502	103,825
Lobster pots: Lobsters.					12,070	15,780
Dredges: Scallops.					12,968	3,340
Grand total.	2,939,152	\$25,386	3,019,962	133,556	33,368,702	\$61,016

YIELD OF SHORE FISHERIES OF MAINE IN 1919, BY COUNTIES, APPARATUS, AND SPECIES.

Apparatus and species.	Cumberland.		Hancock.		Kennebec.		Knox.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Pound nets, trap nets, and weirs:								
Alewives—								
Fresh.	1,125	85	99,636	\$3,128				
Salted.			60	6				
Smoked.			34,373	2,577			55,676	\$3,349
Bluefish.	39	7						
Bonito.	44	4						
Butterfish.	14,507	1,312						
Herring—								
Fresh.	197,420	1,974	20,902,401	110,086			8,858,600	\$6,765
Smoked.							29,000	1,700
Mackerel.	113,686	17,927					9,121	1,187
Pollock.	426,957	8,945	6,700	100				
Salmon, Atlantic.	954	87	7,050	2,795				
Shad.	2,302	650						
Sharks.	16,477	330						
Smelt.			1,600	405				
Sturgeon.	1,616	115						
Tautog.	15	2						
Tuna.	4,089	275						
Whiting—								
Fresh.	608,470	4,000						
Salted.	3,000	90						
Squid.	377	4						
Total.	1,397,477	35,728	21,051,820	119,097			8,952,301	42,992
Lines:								
Catfish and wolfish.	29,820	587						
Cod—								
Fresh.	1,276,020	54,905	1,979,108	52,206			800,078	21,833
Salted.			3,959	300			2,000	300
Cusk.	79,116	2,776	111,956	1,570			51,620	948
Flounders.			7,800	494			8,000	100
Haddock.	377,299	15,939	534,111	22,533			861,270	15,949
Hake—								
Fresh.	1,115,037	45,045	9,525,075	147,450			1,505,965	26,557
Salted.			250	15			500	75
Halibut.	3,844	693	17,380	2,966			22,275	1,322

YIELD OF SHORE FISHERIES OF MAINE IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

Apparatus and species.	Cumberland.		Hancock.		Kennebec.		Knox.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Lines—Continued.								
Pollock, fresh.....	127,244	\$2,637	404,860	\$5,403			324,304	\$6,422
Rosefish.....	1,230	18						
Skates.....	2,142	12						
Smelt.....			73,650	13,250			25,000	5,500
Sounds.....	692	13					4,200	42
Spawn.....	2,196	66						
Livers.....	43,127	433						
Total.....	3,257,746	123,124	12,688,150	246,007			3,157,812	78,359
Gill nets:								
Alewives, smoked.....							15,000	900
Cod, fresh.....	637,735	27,331	360,600	8,580				
Flounders.....	2,000	90						
Haddock.....	21,000	500						
Hake.....			15,000	225				
Mackerel.....	37,895	5,976						
Pollock.....			10,000	125				
Shad.....			2,000	199	7,280	\$1,365		
Sturgeon.....								
Total.....	668,630	33,987	387,600	9,000	7,280	1,365	15,000	900
Seines:								
Herring.....	24,745	247	500,000	4,000				
Mackerel.....			5,000	450				
Pollock.....	518,197	10,831	60,000	1,000				
Shad.....	3,100	216	10,000	700			2,600	200
Smelt.....	119,780	10,780	11,400	1,200			63,600	10,150
Total.....	665,822	22,074	595,400	8,280			66,100	10,350
Bag nets and pocket nets:								
Smelt.....			8,785	1,615	1,350	340		
Tomcod.....					26,500	795		
Total.....			8,785	1,615	27,850	1,135		
Fyke nets:								
Eels.....					500	60		
Suckers.....	3,000	240			55,300	6,540		
Tomcod.....					38,675	1,160		
Total.....	3,000	240			94,475	7,760		
Dip nets:								
Alewives—								
Fresh.....			35,000	500			224,200	484
Smoked.....			5,600	500			38,950	1,947
Smelt.....							5,000	1,500
Total.....			40,600	1,000			268,150	3,931
Eel pots, eel traps, and lobster pots:								
Eels.....			3,050	350	6,550	549	1,000	100
Lobsters.....	670,000	187,880	1,380,114	343,153			1,314,094	336,817
Total.....	670,000	187,880	1,383,164	343,503	6,550	549	1,315,094	336,917
Otter trawls:								
Flounders.....	114,656	3,432	10,000	400			51,950	3,347
Hake.....							45,000	850
Total.....	114,656	3,432	10,000	400			96,950	4,197
Crab traps and cunner traps:								
Crabs, hard.....	70,573	3,505						
Cunner.....	39,635	615						
Total.....	101,270	4,210						
Spears: Eels.			1,000	600				
Harpoons:								
Swordfish.....	2,511	552						
Tuna.....	4,845	325						
Total.....	7,356	877						
Hoes and forks:								
Clams, soft.....	442,650	48,131	636,135	42,416			162,070	10,376
Mussels.....							16,970	367
Total.....	442,650	48,131	636,135	42,416			179,040	10,743
Dredges: Scallops.....			50,800	14,200			28,744	11,867
Grand total.....	7,358,416	459,681	30,836,463	786,218	136,150	10,899	14,079,281	500,256

YIELD OF SHORE FISHERIES OF MAINE IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

Apparatus and species.	Lincoln.		Penobscot.		Sagadahoc.		Waldo.	
Pound nets, trapnets, and weirs:								
Alewives—	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Fresh.....	9,600	\$103	9,000	\$150	2,500	\$50	7,000	410
Smoked.....	24,700	992			74,000	5,700		
Butterfish.....	800	80			16,650	1,538		
Cod.....					900	54	2,300	12
Eels.....					30,350	2,204		
Herring—								
Fresh.....	1,448,750	9,645			581,400	4,411	5,470,880	22,08
Smoked.....	129,000	4,200						
Mackerel.....	11,242	1,431			72,143	8,801	8,707	1,354
Pollock.....					97,400	1,463	4,000	10
Salmon, Atlantic.....			70	30	4,812	1,745	3,857	1,945
Shad.....	5,168	909			21,916	3,297	3,121	220
Smelt.....	850	170			4,985	1,234		
Striped bass.....					535	101	57	12
Sturgeon.....					585	189		
Sturgeon roe.....					30	90		
Suckers.....	4,000	160						
Tomcod.....	500	15						
Whiting, fresh.....					50,600	596		
Total.....	1,623,610	17,705	9,070	180	967,750	31,473	5,508,922	26,399
Lines:								
Cod, fresh.....	353,336	12,361			225,378	10,073	12,000	480
Cusk.....	26,664	827			14,720	587		
Haddock.....	84,092	2,813			31,042	1,147	2,000	30
Hake, fresh.....	400,614	7,777			141,390	6,365	4,300	130
Halibut.....	800	120			11,040	1,750		
Pollock, fresh.....	171,646	3,767			12,250	310		
Salmon, Atlantic.....			630	269				
Smelt.....	16,600	4,150			51,125	12,784		
Total.....	1,054,352	31,815	630	269	486,945	33,916	18,300	690
Gill nets:								
Alewives, fresh.....			10,000	250	700	35		
Cod—								
Fresh.....	374,779	11,071			104,450	5,062		
Salted.....	3,000	180						
Cusk.....	6,371	116						
Haddock.....	84,687	2,259						
Hake.....	419,304	5,909			1,340	40		
Mackerel.....	3,500	426			5,750	175		
Pollock.....	150,582	2,559						
Salmon, Atlantic.....			1,950	832				
Shad.....	28,880	3,625	13	8	17,140	3,063		
Sharks.....	9,000	180						
Smelt.....			300	75	150	88		
Sturgeon.....	900	180			2,192	707		
Sturgeon roe.....					113	207		
Total.....	1,081,003	26,502	12,263	1,165	131,835	9,377		
Seines:								
Herring.....	900,000	6,250			60,000	600		
Mackerel.....	57,425	7,163						
Pollock.....	55,000	1,075						
Shad.....	2,000	200						
Smelt.....	19,950	4,850			5,400	1,350		
Sturgeon.....	50	4						
Total.....	1,034,425	19,542			65,400	1,950		
Bag nets and pocket nets:								
Smelt.....	16,100	4,072	1,600	400	8,500	2,375	23,400	5,82
Tomcod.....	30,000	900	24,000	600			15,000	375
Total.....	46,100	4,972	25,600	1,000	8,500	2,375	38,400	6,595
Fyke nets:								
Eels.....					750	75		
Smelt.....					4,120	1,080		
Suckers.....	36,500	3,650			11,600	1,262		
Tomcod.....	6,660	201						
Total.....	43,160	3,851			15,470	2,367		

YIELD OF SHORE FISHERIES OF MAINE IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

Apparatus and species.	Lincoln.		Penobscot.		Sagadahoc.		Waldo.	
	<i>Pounds.</i>	<i>Value.</i>	<i>Pounds.</i>	<i>Value.</i>	<i>Pounds.</i>	<i>Value.</i>	<i>Pounds.</i>	<i>Value.</i>
Dip nets:								
Alewives—								
Fresh.....	25,600	\$154						
Salted.....	6,800	170						
Smoked.....	80,000	2,400						
Total.....	112,400	2,724						
Eel pots, eel traps, and lobster pots:								
Eels.....	34,500	2,660	24,000	\$2,400	144,550	\$10,246	8,000	\$800
Lobsters.....	619,886	152,327			147,664	39,739	8,800	640
Total.....	654,386	154,987	24,000	2,400	292,214	49,985	16,800	1,440
Otter trawls:								
Flounders.....	43,585	3,486			39,950	3,196		
Hake.....	129,000	2,100			162,800	5,698		
Total.....	163,585	5,586			202,750	8,894		
Spears: Eels.....	17,500	1,400						
Harpoons: Tuna.....	17,300	1,088			5,875	352		
Hoes and forks: Clams, soft.....	192,600	15,252			7,860	899		
Grand total.....	6,040,421	285,424	71,563	5,014	2,185,599	141,588	5,582,472	34,736

Apparatus and species.	Washington.		York.		Total.	
	<i>Pounds.</i>	<i>Value.</i>	<i>Pounds.</i>	<i>Value.</i>	<i>Pounds.</i>	<i>Value.</i>
Pound nets, trap nets, and weirs:						
Alewives—						
Fresh.....	85,750	\$1,421			214,611	\$5,048
Salted.....					60	6
Smoked.....	4,000	300			192,743	12,909
Bluefish.....					39	7
Bonito.....					44	4
Butterfish.....					31,957	2,930
Cod.....	2,000	57			5,200	231
Eels.....	2,000	150			32,350	2,354
Flounders.....	2,500	250			2,500	250
Herring—						
Fresh.....	36,415,781	170,213			73,882,232	355,612
Salted.....	200	12			200	12
Smoked.....	12,550	815			161,550	6,715
Mackerel.....					214,899	30,700
Pollock.....	184,900	3,610			719,957	14,228
Salmon—						
Atlantic.....	645	126			17,388	6,628
Humpback.....	310	62			310	62
Shad.....					39,501	5,076
Sharks.....					16,477	330
Smelt.....	6,245	1,596			13,630	3,345
Striped bass.....					592	113
Sturgeon.....					1,601	304
Sturgeon roe.....					30	90
Suckers.....					4,000	160
Tautog.....					14	2
Tomcod.....					500	15
Tuna.....					4,089	275
Whiting—						
Fresh.....	3,335	50			671,405	4,646
Salted.....					3,000	90
Squid.....					377	4
Total.....	36,720,216	178,662			76,231,256	452,146
Lines:						
Catfish and wolfish.....					29,829	587
Cod—						
Fresh.....	932,352	28,699	260,500	\$14,717	5,894,772	196,095
Salted.....	16,425	1,385	2,600	100	24,384	2,085
Cusk.....	4,069	78	9,000	340	297,085	7,126
Eels.....			2,000	280	2,000	280
Flounders.....			45,400	1,846	58,200	2,320
Haddock.....	124,610	4,834	141,400	9,911	1,886,394	72,297

YIELD OF SHORE FISHERIES OF MAINE IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

Apparatus and species.	Washington.		York.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Lines—Continued.						
Hake—						
Fresh.....	122,635	\$2,211	67,475	\$2,881	12,882,091	\$23,416
Salted.....	4,300	166			5,060	236
Halibut.....	35,165	4,137	3,050	561	96,554	12,019
Pollock—						
Fresh.....	193,150	5,386	82,500	3,416	1,318,954	27,341
Salted.....	25,100	2,095	2,000	100	27,100	2,195
Rosefish.....					1,230	18
Salmon, Atlantic.....					630	290
Sharks.....			1,000	30	1,000	30
Skates.....					2,142	42
Smelt.....					166,375	35,684
Tongues and cheeks.....	200	40	5,000	150	5,200	190
Sounds.....	200	40			5,092	95
Spawn.....					2,196	66
Livers.....	17,000	390			60,127	823
Oil.....	3,750	375	4,875	520	8,625	895
Total.....	1,484,806	50,037	626,200	34,822	22,775,040	509,129
Gill nets:						
Alewives—						
Fresh.....					10,700	285
Smoked.....					15,000	990
Catfish and wolfish.....			100	1	100	1
Cod—						
Fresh.....			44,554	2,102	1,522,118	54,136
Salted.....					3,000	180
Cusk.....			64	1	6,435	117
Flounders.....			240	4	2,240	94
Haddock.....			18,196	674	125,223	3,563
Hake.....					440,054	6,309
Herring—						
Fresh.....	3,000	40			3,000	40
Salted.....	6,900	175			6,000	175
Mackerel.....			9,000	1,080	50,395	7,482
Pollock.....			32,600	947	193,182	3,628
Salmon, Atlantic.....	500	150			2,450	982
Shad.....	4,000	390			57,313	8,421
Sharks.....					9,000	190
Smelt.....	18,350	4,045			18,800	4,158
Sturgeon.....					5,092	1,137
Sturgeon roe.....					113	207
Total.....	31,850	4,800	104,754	4,809	2,470,215	91,965
Seines:						
Flounders.....			10,000	500	10,000	500
Herring.....	1,020,000	4,250			2,504,745	16,247
Mackerel.....			52,000	4,200	114,425	11,515
Pollock.....					642,197	12,996
Shad.....					17,600	1,316
Smelt.....	700	110	4,000	775	224,830	29,215
Sturgeon.....					50	4
Total.....	1,020,700	4,360	66,000	5,475	3,513,847	72,031
Bag nets and pocket nets:						
Smelt.....	11,005	2,535			70,790	17,190
Tomcod.....	5,825	465			101,325	3,135
Total.....	16,830	3,000			172,115	20,324
Fyke nets:						
Eels.....					1,250	137
Smelt.....					4,120	1,030
Suckers.....					106,400	11,692
Tomcod.....					45,335	1,364
Total.....					157,105	14,218
Dip nets:						
Alewives—						
Fresh.....	61,900	900			346,700	2,088
Salted.....					6,800	170
Smoked.....	20,000	950			144,550	3,297
Herring.....	106,000	716			106,000	716
Salmon, Atlantic.....	135	45			135	45
Smelt.....			4,000	800	9,000	2,300
Total.....	188,035	2,611	4,000	800	613,185	11,066

YIELD OF SHORE FISHERIES OF MAINE IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

Apparatus and species.	Washington.		York.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Eel pots, eel traps, and lobster pots:						
Eels.....	16, 300	\$1, 975	10, 000	\$1, 400	247, 950	\$20, 480
Lobsters.....	849, 306	206, 425	493, 000	128, 760	5, 482, 864	1, 395, 741
Total.....	865, 606	208, 400	503, 000	130, 160	5, 730, 814	1, 416, 221
Otter trawls:						
Flounders.....					260, 141	13, 861
Hake.....					327, 800	8, 648
Total.....					587, 941	22, 509
Crab traps and cunner traps:						
Crabs, hard.....					70, 575	3, 595
Cunner.....					30, 695	615
Total.....					101, 270	4, 210
Spears: Eels.....					21, 500	2, 000
Harpoons:						
Swordfish.....			800	200	3, 311	752
Tuna.....					27, 820	1, 765
Total.....			800	200	31, 131	2, 517
Hoes and forks:						
Clams, soft.....	651, 910	43, 365	12, 500	2, 770	2, 105, 734	163, 209
Mussels.....					16, 970	367
Total.....	651, 910	43, 365	12, 500	2, 770	2, 122, 704	163, 576
Dredges: Scallops.....					59, 544	25, 067
Grand total.....	40, 989, 043	495, 175	1, 317, 254	173, 036	114, 587, 667	2, 898, 019

SALMON FISHERY OF PENOBSCOT RIVER AND BAY.

The greater part of the catch of Atlantic salmon in Maine is usually taken in Penobscot River and Bay. In 1920, the latest year for which statistics are available, there were 128 persons engaged in the salmon fishery in these waters. The investment included 68 weirs and traps, valued at \$6,175; 15 gill nets, valued at \$240; rods and lines to the value of \$1,500; 7 gasoline boats, valued at \$700; 85 rowboats, etc., valued at \$2,845; and shore and accessory property, valued at \$1,365; a total of \$12,825. The catch amounted to 1,598 salmon in number, or 15,135 pounds, having a value to the fishermen of \$7,210. The catch in 1919 was 1,322 salmon in number, or 13,557 pounds, valued at \$5,771. The following tables give the extent of this fishery by localities, in 1918, 1919, and 1920, and comparative statistics of the catch for various years from 1895 to 1920:

EXTENT, BY LOCALITIES, OF THE SALMON FISHERY OF PENOBSCOT RIVER AND BAY IN 1918, 1919, AND 1920.

Town.	Weirs and traps.						Gill nets.					
	1918		1919		1920		1918		1919		1920	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Backsport.....	1	\$50	2	\$125	2	\$125						
Orland.....	15	750	16	800	18	900						
Penobscot.....	4	325	7	550	7	525						
Verona.....	21	2, 600	21	2, 750	21	2, 750						
Bangor and Brewer.....												
Hampden.....	1	100	1	100	1	100	8	\$80	5	\$100	8	\$100
Orrington.....							3	60	2	40	1	20
South Orrington.....							6	120	6	120	6	120
Lincolnville.....	11	940	11	940	11	940						
Sandy Point.....	4	475	4	475	4	475						
Winterport.....	3	300	3	300	4	360						
Total.....	62	5, 695	65	6, 040	68	6, 175	17	260	16	260	15	240

EXTENT, BY LOCALITIES, OF THE SALMON FISHERY OF PENOBSCOT RIVER AND BAY IN 1918, 1919, AND 1920—Continued.

Town.	Rods and lines.			Gasoline boats.					
	1918	1919	1920	1918		1919		1920	
	Value.	Value.	Value.	No.	Value.	No.	Value.	No.	Value.
Orland.....				2	\$150	2	\$150	2	\$150
Verona.....				2	175	2	175	2	175
Bangor and Brewer.....	\$900	\$1,200	\$1,500	2	300	2	300	1	100
Hampden.....				1	100				
South Orrington.....				1	150	1	150	1	150
Lincolnville.....				1	125	1	125	1	125
Sandy Point.....				1	100	1	100		
Winterport.....									
Total.....	900	1,200	1,500	10	1,100	9	1,000	7	700

Town.	Rowboats, etc.						Shore and accessory property.			Total investment.		
	1918		1919		1920		1918	1919	1920	1918	1919	1920
	No.	Value.	No.	Value.	No.	Value.						
Bucksport.....	2	\$35	4	\$70	4	\$70	\$10	\$20	\$25	\$95	\$215	\$220
Orland.....	19	385	19	385	20	400	150	150	150	1,435	1,485	1,600
Penobscot.....	6	85	8	115	8	115	40	55	60	450	720	700
Verona.....	20	440	20	440	20	440	175	150	150	3,200	3,515	3,515
Bangor and Brewer.....	23	1,060	23	1,060	23	1,060				2,040	2,360	2,660
Hampden.....	3	105	3	105	3	105	550	550	550	1,115	1,095	875
Orrington.....	6	180	6	180	6	180				300	300	300
South Orrington.....	4	130					50			535		
Lincolnville.....	7	340	7	340	7	340	150	150	150	1,580	1,580	1,580
Sandy Point.....	4	140	4	140	3	110	90	90	90	830	830	800
Winterport.....	4	140	4	140	1	25	190	190	190	730	730	575
Total.....	98	3,040	98	2,975	85	2,845	1,405	1,355	1,365	12,400	12,830	12,825

Town.	Persons engaged.			Catch of salmon. ¹								
	1918	1919	1920	1918			1919			1920		
	No.	Lbs.	Value.	No.	Lbs.	Value.	No.	Lbs.	Value.	No.	Lbs.	Value.
Bucksport.....	1	3	3	30	300	\$105	48	480	\$192	23	207	\$86
Orland.....	13	14	16	56	560	191	55	550	225	94	846	372
Penobscot.....	3	4	4	240	2,400	807	181	1,810	773	290	2,331	1,127
Verona.....	11	11	11	609	6,090	2,188	421	4,210	1,605	636	5,724	2,465
Bangor and Brewer.....	31	31	31	115	1,380	307	133	1,330	568	140	1,540	852
Hampden.....	4	4	3	17	180	103	12	120	52	20	205	111
Orrington.....	12	12	12	80	880	91	120	1,200	511	45	495	266
South Orrington.....	2			70	770	188						
Lincolnville.....	6	6	6	148	1,480	544	105	1,050	525	124	1,116	558
Sandy Point.....	3	3	3	99	1,089	378	85	1,020	500	104	1,054	524
Searsport.....							10	100	50	21	189	95
Stockton Springs.....				103	1,133	395	61	732	364	26	290	140
Winterport.....	3	3	4	86	950	203	91	955	406	106	1,168	622
Total.....	124	126	128	1,653	17,212	5,500	1,322	13,557	5,771	1,598	15,135	7,210

¹ The salmon credited to Orland in 1918, 1919, and 1920, and to Searsport in 1919 and 1920 were taken incidentally with apparatus fished for other species.

CATCH OF SALMON IN PENOBSCOT RIVER AND BAY FOR VARIOUS YEARS.

Year.	Number.	Pounds.	Value.	Year.	Number.	Pounds.	Value.
1895.....	4,395	65,011	\$11,356	1902.....	3,299	45,782	\$9,950
1896.....	6,403	80,225	12,716	1903.....	4,859	67,470	14,035
1897.....	3,985	51,522	7,911	1904.....	4,776	63,395	14,431
1898.....	3,225	42,560	8,342	1905.....	6,378	74,158	17,538
1899.....	3,515	45,688	10,424	1906.....	1,653	17,212	5,300
1900.....	3,541	44,660	7,832	1907.....	1,322	13,557	5,771
1901.....	6,821	86,055	12,263	1908.....	1,598	15,135	7,210

HUMPBACK SALMON.

In recent years humpback or pink salmon from the Pacific coast have been planted by the Bureau in the Dennys, Pembroke, St. Croix, Penobscot, and other rivers in Maine, beginning with the year 1906, and runs of adult fish have appeared during a number of years. The fish occurred in greatest abundance in the early autumn of 1919, when there were large runs in Dennys and Pembroke Rivers, and smaller runs in various other rivers. In July, 1919, a weir fisherman of Perry caught 17 humpback salmon in Little River and sold about 12 fish at \$1 each. They averaged from 4 to 6 pounds in weight. The total catch marketed in 1919 was 310 pounds, valued at \$62. Many were taken and released and probably a considerable number were consumed locally. There seems to be no doubt that this species, if properly protected, can maintain itself in certain New England rivers and become a valuable addition to the local fish supply.

INDUSTRIES.

Wholesale fishery trade.—In 1919, including one plant engaged solely in the production of liver oil, 99 firms engaged in the wholesale trade in fresh and salted fishery products, valued at \$1,722,094, using cash capital to the amount of \$274,550 and giving employment to 872 persons, to whom \$616,858 were paid in wages. As the preparation of by-products is for the most part conducted incidentally to activities in the wholesale trade, the canning and smoked fish industries, the prepared products have been listed under the respective industries. The following table gives the extent of the wholesale trade in fresh and salted fishery products of Maine in 1919:

WHOLESALE TRADE IN FRESH AND SALTED FISHERY PRODUCTS, BY COUNTIES.

Item.	Cumberland.		Hancock.		Knox and Waldo.	
	Number.	Value.	Number.	Value.	Number.	Value.
Plants.....	17	\$346,928	35	\$164,250	19	\$1,058,906
Cash capital.....		38,500		49,000		147,550
Persons engaged.....	149		144		445	
Wages paid.....		124,393		51,105		398,963
Products:						
Liver oil..... gallons..	44,561	58,089	28,750	27,280	11,893	10,517
Other products.....						44,587
Total.....		58,089		27,280		55,104

Item.	Lincoln, Penobscot, and York.		Washington.		Total.	
	Number.	Value.	Number.	Value.	Number.	Value.
Plants.....	9	\$96,160	19	\$55,850	199	\$1,722,094
Cash capital.....		17,100		22,400		274,550
Persons engaged.....	43		91		872	
Wages paid.....		23,638		18,729		616,858
Products:						
Liver oil..... gallons..	5,459	4,596			90,654	100,482
Other products.....						44,587
Total.....		4,596				145,069

¹ Includes one plant engaged solely in production of liver oil.

Smoked-fish industry.—In 1919 there were 50 firms engaged primarily in smoking fishery products in Maine. These plants utilized 23,142,814 pounds of fishery products, valued at \$359,750.

The prepared products amounted to 4,415,582 pounds, valued at \$626,835. The most important items were: Boneless smoked herring, 1,729,219 pounds, valued at \$256,740; whole smoked herring, 1,141,278 pounds, valued at \$102,334; and finnan haddie, 785,333 pounds, valued at \$95,480. The value of the secondary products was \$73,687, which included 730 tons of fish scrap, valued at \$38,500; 1,271,424 pounds of pomace, valued at \$16,411; and 28,044 gallons of herring oil and liver oil, valued at \$18,664.

SMOKED-FISH INDUSTRY OF MAINE IN 1919.

Item.	Number.	Value.	Item.	Number.	Value.
Plants.....	1 50	\$716,589	PRODUCTS—continued.		
Cost of materials.....		109,577	Prepared—Continued.		
Cash capital.....		131,700	Kipperd herring,		
Persons engaged.....	707		pounds.....	1 156,500	\$15,845
Wages paid.....		260,179	Smoked herring—		
PRODUCTS.			pounds.....		
Utilized:			Bloaters..... pounds..	327,330	20,629
Alewives..... pounds..	650	26	Lengthwise.....do....	37,053	2,511
Cod,salted,dried do....	569,055	60,970	Medium scale,		
Haddock.....do.....	8,122,798	192,485	pounds.....	268,534	13,036
Herring—			Boneless.....pounds..	1,729,219	256,740
Fresh.....do.....	9,575,127	69,629	Whole.....do.....	1,141,278	102,334
Smoked.....do.....	247,000	12,712	Other products.....		\$ 120,200
Fish skins, waste, etc.,			Total.....	4,415,582	626,835
pounds.....	3,228,184	10,928	Secondary:		
Pomace.....pounds..	1,400,000	13,000	Oil—		
Total.....	23,142,814	339,750	Herring.....gallons..	23,171	14,086
Prepared:			Liver.....do.....	4,873	4,578
Smoked alewives,			Pomace.....pounds..	1,271,424	16,411
pounds.....	335	60	Fish scrap.....do....	1,460,000	38,500
Finnan haddie,			Other products.....		112
pounds.....	785,333	95,480	Total.....		73,687

¹ Includes one firm in Cumberland County and three in Washington County also engaged in making herring oil, pomace, and fish scrap.

² All smoked herring under products utilized were imported from Canada and used for preparing boneless herring.

³ Includes the output of one plant in Penobscot County and two in Cumberland County listed with canners.

⁴ Includes the output of one plant in Penobscot County listed with canners.

⁵ Includes the value of herring pickled by one firm in Washington County.

Canning industry.—The canning industry of Maine is of growing importance, the chief products packed being sardines, finnan haddie, and clams. In 1919, 77 plants were operated, representing a value of \$4,315,878 and employing cash or working capital to the amount of \$625,257. The cost of materials amounted to \$4,768,040; the number of persons employed was 6,116, to whom \$1,795,506 were paid in wages; and the value of the products utilized was \$1,145,614, of which the most important were: Herring, 128,163,663 pounds, valued at \$875,627; haddock, 6,983,629 pounds, valued at \$149,496; and soft clams, 1,801,070 pounds, valued at \$119,083. It is of interest to note that 19,670 bushels of mussels were utilized, and it is believed that the work of the Bureau in encouraging the use of this product has aided in the development of this fishery. The manufactured products included 2,774,656 cases of canned products, valued at \$13,086,886, and secondary products such as scrap, meal, and oil to the value of \$82,328. The canned products included 2,450,268 cases of sardines, valued at \$11,933,986; 228,127 cases of finnan haddie, valued at \$603,696, and 85,426 cases of clam products, valued at \$439,221.

The clam pack represents the output of nine firms in Washington County, five in Cumberland County, nine in Hancock County, four in Knox County, two in Lincoln County, one in Penobscot County, and one in York County. Of these firms, seven also canned sardines, one mussels, and three smoked fish. As it has been found impracticable to show the pack of clams by grades and counties without disclosing private enterprise, the pack in detailed form has been omitted from the appended table. The pack was made up of the following items: 259 cases of clams in 4-ounce containers, valued at \$1,471; 24,935 cases of 5-ounce cans, valued at \$113,373; 2,954 cases of 6-ounce cans, valued at \$10,930; 6,641 cases of 8-ounce cans, valued at \$49,847; 679 cases of 8½-ounce cans, valued at \$3,058; 4,406 cases of 10-ounce cans, valued at \$20,730; 200 cases of 11-ounce cans, valued at \$760; 19,234 cases of 1-pound cans, valued at \$115,068; 4,199 cases of 2-pound cans, valued at \$25,194; 1,327 cases of No. 3 cans, valued at \$6,348; 74 cases of clam juice in 5-ounce cans, valued at \$222; 3,843 cases of clam juice in 10-ounce cans, valued at \$4,903; 16 cases in No. 1 cans, valued at \$48; 503 cases in No. 10 cans, valued at \$946; and 16,156 cases of clam chowder and bouillon in containers of various sizes, valued at \$86,323.

CANNING INDUSTRY OF MAINE IN 1919, BY COUNTIES.

Item.	Cumberland.		Hancock.		Knox and Waldo.	
	Number.	Value.	Number.	Value.	Number.	Value.
Plants.....	9	\$501,262	17	\$469,590	8	\$240,537
Cost of materials.....		394,446		776,025		194,373
Cash capital.....		537,107		57,530		55,070
Persons engaged.....	569		959		377	
Wages paid.....		179,780		317,380		111,347
PRODUCTS.						
Utilized:						
Cod.....pounds			4,320	86		
Haddock.....do	6,983,629	149,496				
Herring.....do	3,432,898	35,572	21,325,259	152,271	5,424,020	30,945
Clams, soft.....do	48,930	3,444	637,770	37,984	184,910	11,907
Clams, soft, steamed.....do			67,300	9,189		
Mussels.....bushels					19,670	367
Canned:						
Sardines—						
In oil—Quarters.....cases	57,071	452,237	314,909	1,754,761	71,769	369,714
In mustard—						
Quarters.....do	1,340	6,164	9,434	43,559	1,406	6,467
Halves.....do			7,892	66,000		
Three-quarters.....do	12,531	52,477	47,882	258,025	8,871	39,357
In tomato sauce—						
Quarters.....do	1,225	7,446	11,458	60,962	1,302	6,704
Halves.....do	1,071	10,280			2,816	28,732
1 pound.....do	811	9,732				312
Plain—Halves.....do	356	2,631				
Pinnan haddock—						
6½-ounce.....do	197,546	486,134				
8-ounce.....do	25	325				
10½-ounce.....do	29,378	111,638				
1 pound.....do	1,178	5,599				
Total.....	302,532	1,144,663	391,545	2,183,307	86,190	451,286
Secondary: Fish scrap and meal, pounds.....					356,290	14,886
Grand total.....		1,144,663		2,183,307		466,172

¹ Steamed by the fishermen.

² Sardine quarters are packed 100 cans to the case and other sardines usually 48 cans to the case, except half-pound ovals, which sometimes contain 72 cans per case. The number of cans per case of canned clams vary as follows: The 6-oz., 8½-oz., 10-oz., 11-oz., 2-lb., and No. 3 average 2 dozen per case, while the 4-oz., 5-oz., 6-oz., and 1-lb. average 4 dozen per case. The clam juice, 5-oz., 10-oz., and No. 1 cans, average 2 dozen per case, and the No. 10 are packed one-half dozen to the case. The one-half pound kippered herring are packed 8 dozen to the case, and the 1-lb. cans are packed 4 and 6 dozen to the case.

CANNING INDUSTRY OF MAINE IN 1919, BY COUNTIES—Continued.

Item.	Lincoln, Penobscot, and York.		Washington.		Total.	
	Number.	Value.	Number.	Value.	Number.	Value.
Plants.....	4	\$84,023	139	\$2,930,466	77	\$4,315,828
Cost of materials.....		15,873		3,497,323		4,768,040
Cash capital.....		21,430		154,100		625,287
Persons engaged.....	106		4,106		6,116	
Wages paid.....		18,213		1,168,786		1,795,506
PRODUCTS.						
Utilized:						
Cod.....pounds..			36,616	955	40,336	1,041
Haddock.....do..					6,983,629	149,496
Herring.....do..	101,553	1,800	97,859,933	655,039	128,163,663	875,627
Clams, soft.....do..	134,190	9,582	727,970	46,977	1,753,770	109,894
Clams, soft, steamed.....do..					67,300	9,189
Mussels.....bushels.					19,670	967
Canned: ²						
Sardines—						
In oil—						
Quarters.....cases.			1,458,681	6,760,953	1,902,430	9,327,665
Halves.....do..			878	11,500	878	11,500
In mustard—						
Quarters.....do..			115,484	546,607	127,664	602,797
Halves.....do..					7,962	66,000
Three-quarters.....do..			242,363	973,555	311,647	1,323,414
In tomato sauce—						
Quarters.....do..			76,407	457,073	90,392	532,185
Halves.....do..			1,166	5,522	5,063	44,384
1 pound.....do..			1,334	6,413	2,171	16,457
Plain—						
Halves.....do..			127	490	433	3,121
No. 1.....do..			1,688	6,313	1,688	6,313
Kipperd herring—						
Half pound.....do..					1,917	15,386
1 pound.....do..					7,631	86,386
Finnan haddie—						
6½-ounce.....do..					197,546	488,131
8-ounce.....do..					25	325
10½-ounce.....do..					29,375	111,638
1 pound.....do..					1,178	5,699
Clams (various sizes).....do..					85,426	439,221
Miscellaneous.....do..					1,287	5,212
Total.....			1,898,128	8,758,436	2,774,656	13,086,886
Secondary:						
Fish scrap and meal.....pounds..			1,972,000	66,959	2,328,200	81,845
Herring oil.....gallens..			690	483	690	483
Total.....				67,442		82,328
Grand total.....				8,825,868		13,169,214

¹ This includes one plant located at Belfast, in Waldo County.² See footnote 2 on p. 149.

Sardine industry in 1919 and 1920.—In 1919, 53 plants were engaged in canning sardines, employing 5,463 persons, to whom \$1,685,409 were paid in wages. The plants were valued at \$3,764,875, the cost of materials used was \$4,556,963, and the working capital amounted to \$256,107. The herring utilized amounted to 125,309,415 pounds, valued at \$852,450. The total pack was 2,450,268 cases, valued at \$11,933,986, of which 1,902,430 cases, valued at \$9,327,665, were quarter oils.

In 1920 the number of plants operated was 50, valued at \$3,816,388; the cost of materials amounted to \$3,907,878; the working capital was \$250,000; and the number of persons employed was 5,109, to

whom \$1,787,402 were paid in wages. The herring utilized amounted to 104,700,010 pounds, valued at \$767,141, and the pack was 1,877,757 cases, valued at \$7,435,056, of which 1,458,670 cases, valued at \$5,669,352, were quarter oils.

The detailed statistics of the sardine industry of Maine in 1919 and 1920, by counties, are shown in the appended tables:

SARDINE INDUSTRY OF MAINE IN 1919 AND 1920, BY COUNTIES.

1919.

Item.	Cumberland.		Hancock.		Knox and Waldo.	
	Number.	Value.	Number.	Value.	Number.	Value.
Plants.....	5	\$172,673	10	\$436,090	5	\$225,146
Cost of material.....		241,504		741,150		185,186
Cash capital.....		26,107		46,000		40,000
Persons engaged.....	392		832		235	
Wages paid.....		128,187		303,621		100,769
PRODUCTS.						
Herring utilized.....	Pounds. 3,395,203	Value. \$34,992	Pounds. 21,325,259	Value. \$152,271	Pounds. 5,424,020	Value. \$30,945
Canned sardines: ¹						
In oil—	Cases.	Value.	Cases.	Value.	Cases.	Value.
Quarters.....	57,071	\$452,237	314,909	\$1,754,761	71,769	\$369,714
Halves.....						
In mustard—						
Quarters.....	1,340	6,164	9,434	43,559	1,406	6,467
Halves.....			7,862	66,000		
Three-quarters.....	12,531	32,477	47,882	258,025	8,871	39,357
In tomato sauce—						
Quarters.....	1,225	7,446	11,458	60,962	1,302	6,704
Halves.....	1,071	10,280			2,816	28,732
One pound.....	811	9,732			26	312
Plain—						
Half-pound.....	356	2,631				
Number one.....						
Total sardines.....	74,405	540,967	391,545	2,183,307	86,190	451,286

Item.	Washington.		Total.	
	Number.	Value.	Number.	Value.
Plants.....	133	\$2,910,966	53	\$3,764,875
Cost of material.....		3,389,123		4,556,963
Cash capital.....		144,000		256,107
Persons engaged.....	4,004		5,463	
Wages paid.....		1,152,832		1,685,409
PRODUCTS.				
Herring utilized.....	Pounds. 95,164,933	Value. \$634,242	Pounds. 125,309,415	Value. \$852,450
Canned sardines: ²				
In oil—	Cases.	Value.	Cases.	Value.
Quarters.....	1,458,681	\$6,750,953	1,902,430	\$9,327,665
Halves.....	878	11,500	878	11,500
In mustard—				
Quarters.....	115,484	546,607	127,664	602,797
Halves.....			7,862	66,000
Three-quarters.....	242,303	973,555	311,647	1,323,414
In tomato sauce—				
Quarters.....	76,407	457,073	90,392	532,185
Halves.....	1,166	5,522	5,053	44,534
One pound.....	1,334	6,413	2,171	16,457
Plain—				
Half-pound.....	127	490	483	3,121
Number one.....	1,688	6,313	1,688	6,313
Total sardines.....	1,898,128	8,758,426	2,450,268	11,933,986

¹ Includes one plant located at Belfast, in Waldo County.

² Sardines are packed 100 cans to the case and others usually 48 cans to the case, except half-pound ovals, which sometimes contain 72 cans to the case.

SARDINE INDUSTRY OF MAINE IN 1919 AND 1920, BY COUNTIES—Continued.

1920.

Item.	Cumberland.		Hancock.		Knox and Waldo.	
	Number.	Value.	Number.	Value.	Number.	Value.
Plants.....	6	\$204,132	8	\$567,643	3	\$345,009
Cost of material.....		133,071		302,975		81,772
Cash capital.....		37,000		37,000		6,500
Persons engaged.....	432		649		171	
Wages paid.....		89,285		109,752		64,820
PRODUCTS.						
Herring utilized.....	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
	3,073,468	\$30,114	9,878,319	\$80,701	2,034,800	\$18,915
Canned sardines: ¹						
In oil—	Cases.	Value.	Cases.	Value.	Cases.	Value.
Quarters.....	36,510	\$206,232	142,985	\$789,168	22,077	\$149,628
Halves.....			2,228	22,280		
In mustard—						
Quarters.....	1,226	4,523	6,261	31,824	51	204
Three-quarters.....	5,492	16,650	18,067	89,842	785	3,242
In tomato sauce—						
Quarters.....	3,317	15,155	6,143	25,499	2,949	11,796
Halves.....	150	1,080			1,331	15,956
Three-quarters.....						
One pound.....	18,075	75,846			3,712	83,406
Total sardines.....	64,770	319,486	175,684	958,613	30,905	214,234

Item.	Washington.		Total.	
	Number.	Value.	Number.	Value.
Plants.....	133	\$2,799,604	50	\$3,816,288
Cost of material.....		3,300,060		3,907,878
Cash capital.....		109,500		250,000
Persons engaged.....	8,837		5,109	
Wages paid.....		1,463,845		1,787,402
PRODUCTS.				
Herring utilized.....	Pounds.	Value.	Pounds.	Value.
	89,713,423	\$840,411	104,700,010	\$767,141
Canned sardines: ²				
In oil—	Cases.	Value.	Cases.	Value.
Quarters.....	1,257,098	\$4,524,324	1,438,670	\$5,669,332
Halves.....			2,228	22,280
In mustard—				
Quarters.....	43,945	185,493	51,483	222,044
Three-quarters.....	158,625	586,330	182,969	696,061
In tomato sauce—				
Quarters.....	145,905	641,832	158,314	694,282
Halves.....			1,481	17,036
Three-quarters.....	348	1,643	348	1,643
One pound.....	477	3,101	22,264	112,355
Total sardines.....	1,606,398	5,942,723	1,877,757	7,435,069

¹ Includes two plants located in Waldo County.² Quarters are packed 100 cans to the case and others usually 48 cans to the case, except half-pound ovals, which sometimes contain 72 cans to the case.

FISHERIES OF NEW HAMPSHIRE.

The coastal fisheries of New Hampshire are unimportant in comparison with the fisheries of the other New England States and are confined to Rockingham County, the only coastal county. In 1919 the number of persons employed was 100, of whom 3 were on a vessel transporting fishery products, 85 in the shore and boat fisheries, and 12 shoresmen in wholesale fish establishments. The amount of capital invested was \$45,530 and included: A transporting vessel with outfit, valued at \$9,300; 31 small boats, valued at \$802; 53 power boats, valued at \$10,675; fishing apparatus in the shore fish-

eries to the value of \$7,295; shore and accessory property with a value of \$11,958, and cash capital amounting to \$5,500.

The products amounted to 528,730 pounds, valued at \$92,660. The species of chief importance were as follows: Lobsters, 298,012 pounds, valued at \$73,203; soft clams, 66,600 pounds, valued at \$13,320; and cod, 98,354 pounds, valued at \$3,609.

Compared with 1905, there has been a decrease of 45 in the number of persons employed, of \$1,520 in the capital invested, and of 507,722 pounds in the quantity of products; but an increase in the value of the products of \$40,716. There has been an increase in the catch of lobsters as compared with 1905 of 41,960 pounds in quantity and \$40,628 in value and a decrease in the collection of Irish moss of 54,000 pounds in quantity and \$1,980 in the value.

FISHERIES OF ROCKINGHAM COUNTY.

The following table shows the number of persons employed, the investment, and the quantity and value of the products of the fisheries of Rockingham County, N. H., in 1919:

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF FISHERIES OF ROCKINGHAM COUNTY, N. H., IN 1919.

Item.	Number.	Value.	Item.	Number.	Value.
PERSONS ENGAGED.			INVESTMENT—continued.		
On vessels transporting.....	3	.....	Shore and accessory property.....		\$11,958
Inshore fisheries.....	85	.....	Cash capital.....		5,500
Shoresmen.....	12	.....	Total.....		45,530
Total.....	100	.....	PRODUCTS.		
INVESTMENT.				Pounds.	Value.
Vessels transporting: Gasoline	1	\$6,300	Cod.....	98,354	3,609
Tonnage.....	8	.....	Cusk.....	2,400	86
Outfit.....		3,000	Eels.....	2,000	240
Boats:			Flounders.....	8,000	240
Sail, row, etc.....	31	802	Haddock.....	18,764	829
Power.....	53	10,675	Hake.....	3,000	98
Apparatus, shore fisheries:			Pollock.....	25,600	615
Handline.....		70	Lobsters.....	298,012	73,203
Trawl lines.....		392	Clams, soft.....	66,600	13,320
Lobster pots.....	2,275	6,735	Irish moss.....	6,000	420
Eel pots.....	18	36	Total.....	528,730	92,660
Clam hoes.....	25	50			
Moss rakes.....	2	12			

¹ 6,660 bushels.

FISHERIES BY APPARATUS.

No vessels were employed in the capture of fish in 1919. The largest quantity in the shore fisheries, consisting of 298,012 pounds of lobsters, valued at \$73,203, was taken with lobster pots. The catch with hand lines, amounting to 156,118 pounds, valued at \$5,477, was second, and the catch of soft clams with clam hoes, third. The principal species taken with hand lines were cod, pollock, haddock, and flounders. The following table gives the products of the shore fisheries in 1919 by apparatus and species:

YIELD OF THE SHORE FISHERIES OF NEW HAMPSHIRE IN 1919, BY APPARATUS AND SPECIES.

Apparatus and species.	Pounds.	Value.	Apparatus and species.	Pounds.	Value.
Lines:			Lobster pots: Lobsters.....	298,012	\$73,203
Cod.....	98,354	\$3,609	Eel pots: Eels.....	2,000	240
Cusk.....	2,400	86	Clam hoes: Soft clams.....	66,600	13,320
Flounders.....	8,000	240	Moss rakes: Irish moss.....	6,000	420
Haddock.....	18,764	829	Grand total.....	528,730	92,660
Hake.....	3,000	98			
Pollock.....	25,600	615			
Total.....	156,118	5,477			

WHOLESALE FISHERY TRADE.

There were only 2 wholesale fresh-fish establishments in Rockingham County in 1919, valued at \$7,540, using cash capital to the amount of \$5,500 and employing 12 persons, to whom \$12,678 were paid in wages.

FISHERIES OF MASSACHUSETTS.

The fisheries of Massachusetts in 1919 were more productive than those of all the other New England States combined. The number of persons employed was 12,346, of whom 4,459 were on fishing vessels, 66 on vessels transporting fishery products, 3,737 in the shore and boat fisheries, and 4,084 shoresmen in the wholesale plants, canneries, salteries, smokehouses, by-products plants, and other shore establishments.

The investment included 421 fishing and transporting vessels, valued at \$6,192,118, having a net tonnage of 16,838 tons and out-fits valued at \$1,860,766; 3,040 power, sail, row, and other small boats, valued at \$949,683; apparatus employed in the vessel and boat fisheries to the value of \$1,205,518; shore and accessory property valued at \$7,000,239, and cash capital to the amount of \$1,902,945, making a total investment of \$19,111,269.

The products of the fisheries amounted to 246,951,241 pounds, valued at \$10,859,746. The most important species arranged in the order of their value were: Cod, 69,496,325 pounds, valued at \$2,992,793; haddock, 78,178,384 pounds, valued at \$2,208,211; common mackerel, 13,516,194 pounds, valued at \$1,322,409; lobsters, 2,387,636 pounds, valued at \$516,393; flounders, 10,262,693 pounds, valued at \$478,850; pollock, 19,242,541 pounds, valued at \$469,943; and scallops, 1,332,486 pounds, or 222,081 bushels, valued at \$439,382.

Compared with the Bureau's returns for 1905 there has been a decrease in the number of persons employed of 3,348, an increase in the investment amounting to \$8,300,827, a decrease in the quantity of products taken amounting to 8,703,234 pounds, and an increase in the value amounting to \$3,834,497. The species for which there has been a notable increase in 1919 as compared with 1905, with the amount of increase follow: Flounders, 6,219,010 pounds; squid, 5,348,807 pounds; whiting, 9,618,960 pounds; lobsters, 1,104,565 pounds; scallops, 1,069,249 pounds; and hard crabs, 1,704,961 pounds. Those for which there has been a marked decrease as compared with 1905 are: Alewives, 1,673,820 pounds; cusk, 5,877,991 pounds; hake, 16,605,435 pounds; halibut, 1,796,447 pounds; and herring, 7,553,045 pounds.

FISHERIES BY COUNTIES.

The statistics of the number of persons employed, investment, and products of the fisheries in Massachusetts in 1919 are given by counties in the appended table:

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF FISHERIES OF MASSACHUSETTS IN 1919, BY COUNTIES.

Item.	Barnstable.		Bristol.		Dukes.	
	Number.	Value.	Number.	Value.	Number.	Value.
PERSONS ENGAGED.						
On vessels fishing.....	504		218		54	
On vessels transporting.....	6					
Inshore fisheries.....	1,386		355		229	
Shoresmen.....	638		169		34	
Total.....	2,534		742		317	
INVESTMENT.						
Vessels fishing:						
Steam.....	1	\$12,000				
Tonnage.....	55					
Outfit.....		4,400				
Gasoline.....	68	186,150	15	\$52,500	14	\$50,100
Tonnage.....	626		160		128	
Outfit.....		88,940		24,900		16,210
Sail.....	12	139,500	6	98,200		
Tonnage.....	1,259		829			
Outfit.....		126,525		24,200		
Vessels transporting:						
Gasoline.....	3	8,500				
Tonnage.....	17					
Outfit.....		450				
Boats:						
Sail, row, etc.....	633	39,000	149	3,145	70	3,043
Power.....	500	238,770	161	43,375	167	74,125
Apparatus, vessel fisheries:						
Purse seines.....	15	32,800	8	3,650	3	2,100
Gill nets.....	661	13,835	340	5,550	555	10,080
Otter trawls.....	35	2,645	4	300	5	300
Lines, hand and trawl.....		8,294		960		2,694
Harpoons.....		800		925		725
Lobster pots.....	75	150	80	200	275	700
Dredges.....	158	1,571	2	30	12	60
Tongs.....			1	9		
Whaling apparatus.....		12,000		17,000		
Apparatus, shore fisheries:						
Purse seines.....	4	2,600			1	150
Haul seines.....	13	1,085	6	415	3	540
Gill nets.....	881	13,370	20	275	40	640
Pound nets, trap nets, and weirs.....	151	326,700	18	8,200	31	22,100
Fyke nets.....	44	1,010	7	475	2	100
Bow nets.....	13	36				
Dip nets.....	63	138				
Otter trawls.....	36	1,970	2	170	52	2,875
Lines, hand and trawl.....		10,250		152		91
Harpoons.....				60		480
Spears.....	27	51	29	83		
Cunner traps.....			4	6		
Cockle traps.....	400	360				
Lobster pots.....	2,750	5,549	7,352	15,762	5,543	15,661
Eel pots.....	738	1,503	55	100	587	1,545
Dredges.....	1,086	7,561	256	1,280	416	2,080
Tongs.....	115	674	70	390		
Rakes.....	537	2,219	92	1,054	54	1,080
Forks and hoes.....	139	286	1	1	7	14
Shore and accessory property.....		1,492,266		124,035		66,405
Cash capital.....		83,650		16,000		9,000
Total.....		2,867,608		443,402		291,898
PRODUCTS.						
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Alewives:						
Fresh.....	313,466	\$5,634	104,795	\$2,075	551,150	\$14,141
Salted.....	801,600	36,620	60,534	2,220	140,000	6,300
Smoked.....	39,000	2,845				
Bluefish.....	3,932	696			121	24
Bonito.....	33,956	2,549	40	4	95,461	9,929
Butterfish.....	180,500	15,577	11,700	850	56,899	5,853

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF FISHERIES OF MASSACHUSETTS
IN 1919, BY COUNTIES—Continued.

Item.	Barnstable.		Bristol.		Dukes.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
PRODUCTS—continued.						
Catfish and wolfish.....	20,976	\$330				
Cod:						
Fresh.....	6,132,372	229,207	176,870	\$10,697	201,259	\$14,313
Salted.....	6,500	450				
Cunners.....			7,150	500		
Cusk, fresh.....	16,428	436				
Eels.....	112,708	16,912	24,778	2,880	79,500	11,805
Flounders.....	3,979,872	161,782	187,123	9,058	913,238	56,457
Grayfish.....	1,000	10	62,667	174		
Goosefish.....			2,500	7		
Haddock, fresh.....	5,865,917	172,356			65,534	4,533
Hake, fresh.....	6,444,902	15,839	2,763	180	15,086	1,501
Halibut, fresh.....	19,318	4,385	20,000	5,000		
Herring.....	6,445,441	80,284	88,765	1,373	25	3
Hickory shad.....	11,650	780	1,150	50		
Kingfish.....			72	18		
Launce.....	67,800	838				
Mackerel:						
Fresh.....	3,596,851	337,779	263,445	26,526	335,337	41,320
Frigate.....					61,361	1,962
Menhaden.....	69,303	1,605	46,516	272	5,400	54
Minnows.....	1,000	125				
Perch, white.....			200	20	6,000	600
Pollock, fresh.....	1,242,907	29,740	140	5	45,871	1,398
Pompano.....	14	2				
Rosefish.....	305	9				
Round herring.....	941	19				
Sculpin.....			6,000	15		
Scup.....	10,344	759	82	6	65,278	4,636
Sea bass.....	345	110	2,289	50	10,365	1,182
Sea robin.....			400	1		
Shad.....	5,645	1,553	352	85	87	7
Sharks.....	314,525	3,220	3,175	71		
Skates and rays.....	885	17	93,649	381		
Smelt.....	257	38	97	13		
Squeteague.....	613	74	962	151	4,202	651
Striped bass.....	307	115	605	103	59	13
Sturgeon.....	5,183	1,191				
Sturgeon caviar.....	30	85				
Sturgeon roe.....	175	150				
Swordfish.....	112,935	20,860	100,141	22,865	121,538	25,740
Tautog.....	35,427	2,589	46,369	5,421	822	49
Tilefish.....			38,000	1,330		
Tomcod.....	2,200	6	4,690	183		
Tuna.....	37,048	2,716	53	2		
Whiting.....	11,173,383	135,485	57,709	948	62,727	365
Other species.....	9,500	100	8,411	388	20,321	1,629
Squid.....	5,837,988	104,364	141,129	2,184	16,459	233
Blackfish.....	40,000	40				
Porpoise.....	750	15				
Clams:						
Hard—						
Public.....	293,520	99,348	195,360	63,600	79,120	27,300
Private.....	22,640	12,425				
Soft—						
Public.....	136,000	13,189	6,000	900	5,000	875
Private.....	125,000	10,750				
Razor.....	23,300	3,500				
Oysters:						
Market—						
Public.....	875	150	1,120	400		
Private.....	723,835	265,397	21,945	5,380		
Seed—Private.....	68,978	5,912				
Scallops.....	501,264	145,523	42,300	14,200	301,020	88,325
Cockles.....	2,400	1,025				
Lobsters.....	99,420	26,988	256,618	54,402	619,497	104,610
Shrimp.....	3,100	1,550				
Spawn.....	37,107	1,601				
Livers.....	150	1				
Sperm oil.....	678,375	92,450	867,038	125,661		
Ambergris.....	30	5,000				
Alewife scales.....	4,000	2,000				
Total.....	49,916,193	2,077,114	2,964,672	360,649	3,869,707	428,770

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF FISHERIES OF MASSACHUSETTS
IN 1919, BY COUNTIES—Continued.

Item.	Essex.		Nantucket.		Norfolk.	
PERSONS ENGAGED.	Number.	Value.	Number.	Value.	Number.	Value.
On vessels fishing.....	2,345		43			
On vessels transporting.....	30		3			
Inshore fisheries.....	624		100		45	
Shoresmen.....	2,058		6		2	
Total.....	5,057		152		47	
INVESTMENT.						
Vessels fishing:						
Steam.....	11	\$302,065	1	\$4,000		
Tonnage.....	931		15			
Outfit.....		119,866		1,650		
Gasoline.....	146	1,950,303	13	24,200		
Tonnage.....	5,302		122			
Outfit.....		671,348		16,075		
Sail.....	23	379,500	1	100		
Tonnage.....	1,780		5			
Outfit.....		110,222		15		
Vessels transporting:						
Gasoline.....	5	59,350	1	300		
Tonnage.....	290		6			
Outfit.....		3,170				
Sail.....	3	13,800				
Tonnage.....	132					
Outfit.....		2,375				
Boats:						
Sail, row, etc.....	163	4,435	20	700	21	\$680
Power.....	324	152,390	78	25,655	31	7,450
Apparatus, vessel fisheries:						
Purse seines.....	64	130,700	1	600		
Gill nets.....	3,089	63,875	100	1,600		
Otter trawls.....	36	4,145	6	360		
Lines, hand and trawl.....		82,495				
Harpoons.....		2,780		200		
Dredges.....			42	795		
Rakes.....			2	40		
Apparatus, shore fisheries:						
Purse seines.....	20	39,000				
Haul seines.....	11	575				
Gill nets.....	1,724	40,363	10	1,500		
Pound nets, trap nets, and weirs.....	43	19,650	3	3,000		
Dip nets.....	12	63				
Otter trawls.....	25	1,440	32	835		
Lines, hand and trawl.....		14,797		265		70
Spears.....	6	11			8	20
Cockle traps.....	280	140				
Lobster pots.....	10,859	26,929	622	1,866	2,289	6,440
Eel pots.....	119	326	180	540	15	45
Dredges.....			384	1,720		
Rakes.....			40	1,010	5	30
Forks and hoes.....	134	208			11	22
Shore and accessory property.....		3,563,906		30,165		3,145
Cash capital.....		374,795		3,000		1,200
Total.....		8,335,022		120,191		19,102
PRODUCTS.						
Alewives:	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Fresh.....	29,815	\$344	16,400	\$164		
Salted.....			27,000	1,080		
Bluefish.....	668	71				
Bonito.....	670	54	59,400	5,470		
Butterfish.....	20,469	2,126				
Catfish and wolfish.....	64,236	1,991				
Cod:						
Fresh.....	39,449,727	1,695,709	192,400	8,120	22,000	\$1,760
Salted.....	3,137,905	162,452	30,000	3,600		
Cunners.....	2,809	85				
Cusk:						
Fresh.....	1,073,168	37,681				
Salted.....	10,870	759				
Eels.....	113,991	10,177	30,000	4,500	3,000	530
Flounders.....	2,171,726	93,786	611,210	49,090	8,000	800
Haddock:						
Fresh.....	25,468,751	714,799	16,100	508	500	40
Salted.....	373,574	16,996				

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF FISHERIES OF MASSACHUSETTS
IN 1919, BY COUNTIES—Continued.

Item.	Essex.		Nantucket.		Norfolk.	
PRODUCTS—continued.						
Hake:	<i>Pounds.</i>	<i>Value.</i>	<i>Pounds.</i>	<i>Value.</i>	<i>Pounds.</i>	<i>Value.</i>
Fresh.....	1,957,170	\$79,601				
Salted.....	29,095	1,307				
Halibut:						
Fresh.....	1,435,835	249,254				
Salted.....	8,045	1,060				
Herring.....	2,241,108	29,625	2,000	\$300		
Mackerel:						
Fresh.....	6,953,882	661,856	89,700	7,925		
Salted.....	1,249,062	109,948				
Perch, yellow.....	500	25				
Pollock:						
Fresh.....	13,956,759	341,242	28,400	1,486	1,000	\$0.80
Salted.....	50,153	1,774				
Rosefish.....	20,150	487				
Scup.....			2,450	245		
Sea bass.....	18	2	2,000	300		
Shad.....	33,366	1,297	12,800	750		
Sharks.....	9,594	319				
Skates and rays.....	3,510	56				
Smelt.....	7,796	1,864			22,200	6,425
Sturgeon.....	1,080	103	4,500	1,800		
Sturgeon caviar.....		120		271		
Sturgeon roe.....	6	13				
Swordfish.....	275,542	64,951	1,300	214		
Tautog.....	158	6			2,000	180
Tilefish.....	116,670	7,000				
Tuna.....	5,000	750				
Whiting.....	2,564,231	11,343	53,600	660		
Squid.....	121,831	1,671	3,350	83		
Clams:						
Hard, public.....	600	75	247,944	68,836		
Soft, public.....	460,060	58,206			63,470	6,630
Scallops.....			103,452	46,230		
Cockles.....	300,000	1,350				
Crabs, hard.....	18,167	395			18,475	354
Lobsters.....	677,387	161,249	19,446	8,759	77,054	19,390
Shrimp.....	300	39				
Tongues.....	600	12				
Spawn.....	57,462	3,401				
Livers.....	282,875	4,366				
Irish moss.....					25,500	1,912
Total.....	104,762,381	4,531,677	1,553,572	210,391	243,199	41,291

Item.	Plymouth.		Suffolk.		Total.	
PERSONS ENGAGED.	<i>Number.</i>	<i>Value.</i>	<i>Number.</i>	<i>Value.</i>	<i>Number.</i>	<i>Value.</i>
On vessels fishing.....	2		1,293		4,459	
On vessels transporting.....			27		66	
Inshore fisheries.....	485		513		3,737	
Shoresmen.....	99		1,078		4,084	
Total.....	586		2,911		12,346	
INVESTMENT.						
Vessels fishing:						
Steam.....			21	\$1,960,480	34	\$2,484,546
Tonnage.....			2,309		3,310	
Outfit.....				394,045		429,961
Gasoline.....	1	\$2,500	51	501,755	308	2,776,506
Tonnage.....	8		1,856		8,202	
Outfit.....		120		241,845		1,050,438
Sail.....			12	191,015	54	808,315
Tonnage.....			861		4,734	
Outfit.....				91,350		352,312
Vessels transporting:						
Gasoline.....			13	40,800	22	108,960
Tonnage.....			147		460	
Outfit.....				13,060		16,690
Sail.....					3	13,800
Tonnage.....					132	
Outfit.....						2,375

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF FISHERIES OF MASSACHUSETTS
IN 1919, BY COUNTIES—Continued.

Item.	Plymouth.		Suffolk.		Total.	
INVESTMENT—continued.						
Boats:	<i>Number.</i>	<i>Value.</i>	<i>Number.</i>	<i>Value.</i>	<i>Number.</i>	<i>Value.</i>
Sail, row, etc.	219	\$5,655	33	\$1,830	1,308	\$58,488
Power	280	90,570	191	258,860	1,732	891,195
Apparatus, vessel fisheries:						
Purse seines			9	24,000	100	193,850
Gill nets			685	12,745	5,430	107,685
Other trawls			33	10,100	119	17,850
Lines, hand and trawl				39,215		133,658
Harpoons				1,225		6,655
Loose pots					430	1,050
Dredges	10	60			224	2,516
Tones					1	9
Rakes					2	40
Whaling apparatus						29,000
Apparatus, shore fisheries:						
Purse seines	1	300			25	42,050
Haul seines	2	190	6	1,290	41	3,995
Gill nets	38	1,675	975	19,500	3,688	77,323
Pound nets, trap nets, and weirs	8	7,820			254	387,470
Fyke nets					53	1,585
Row nets					13	36
Dip nets	22	132	7	41	104	374
Other trawls	2	120	42	2,100	191	9,510
Lines, hand and trawl		719		25,068		51,412
Harpoons						540
Spears	2	6			72	171
Cunner traps					4	6
Cockle traps					680	500
Loose pots	11,347	31,182	2,250	5,970	43,012	109,359
Dredges	132	396			1,825	4,455
Tones	622	3,890			2,764	16,521
Rakes	50	241			235	1,355
Forks and hoes	56	263			784	5,656
Shore and accessory property	130	265	53	91	475	887
Cash capital		106,136		1,614,181		7,000,239
		7,300		1,408,000		1,902,945
Total		259,570		6,774,476		19,111,269
PRODUCTS.	<i>Pounds.</i>	<i>Value.</i>	<i>Pounds.</i>	<i>Value.</i>	<i>Pounds.</i>	<i>Value.</i>
Alewives:						
Fresh	81,050	\$704	800	\$8	1,097,476	\$23,070
Salted	230,000	9,775			1,259,134	55,995
Smoked					39,000	2,845
Bluefish					4,721	791
Bonito			200	12	189,727	18,018
Butterfish	4,775	517	22,485	1,887	206,828	26,810
Catfish and wolfish			205,976	6,898	291,188	9,219
Cod:						
Fresh	182,113	7,926	19,964,179	858,359	66,320,920	2,826,091
Salted	1,000	290			3,175,405	166,792
Cunners					9,859	585
Cusk:						
Fresh	3,000	84	468,741	16,867	1,561,337	55,068
Salted					16,870	759
Eels	9,700	1,263	490	7	374,167	47,714
Flounders	42,700	1,994	2,348,824	102,883	10,262,693	478,850
Grayfish					63,667	184
Goosefish					2,500	7
Haddock:						
Fresh	4,750	183	46,383,298	1,298,776	77,894,810	2,191,215
Salted					373,574	16,996
Hake:						
Fresh	3,100	125	1,443,416	59,107	4,066,437	156,352
Salted					29,095	1,307
Halibut:						
Fresh			233,356	37,593	1,798,569	296,232
Salted					8,045	1,060
Herring	1,810,600	11,519	223,470	6,304	10,811,409	129,408
Hickory shad					12,800	830
Kingfish					72	18
Launce					67,800	838
Mackerel:						
Fresh	48,887	5,991	979,030	131,064	12,267,132	1,212,461
Salted					1,249,062	109,948
Frigate					61,361	1,862
Menhaden	40,000	300			161,219	2,231
Minnows					1,000	125

**PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF FISHERIES OF MASSACHUSETTS
IN 1919, BY COUNTIES—Continued.**

Item.	Plymouth.		Suffolk.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
PRODUCTS—continued.						
Perch:						
White.....					6,200	\$920
Yellow.....					500	25
Pollock:						
Fresh.....	15,600	\$474	3,001,711	\$93,735	19,192,388	458,169
Salted.....					50,153	1,774
Pompano.....					14	2
Rosefish.....			16,318	628	36,773	1,124
Round herring.....					941	19
Sculpin.....					6,000	15
Scup.....	500	30			78,824	5,606
Sea bass.....	50	5			15,067	1,649
Sea robin.....					400	1
Shad.....			10,137	617	62,337	4,309
Sharks.....			1,105	54	328,899	3,654
Skates and rays.....			2,310	49	100,354	523
Smelt.....	7,500	2,025	1,300	325	39,150	10,600
Squeteague.....					5,777	908
Striped bass.....					971	231
Sturgeon.....			1,339	264	12,098	3,358
Sturgeon caviar.....					150	356
Sturgeon roe.....					181	161
Swordfish.....			91,313	20,700	711,729	155,330
Tautog.....	7,100	640			91,876	8,889
Tilfish.....			33,510	1,473	188,180	9,903
Tomcod.....			1,000	50	7,800	239
Tuna.....	800	80			42,901	3,548
Whiting.....	7,000	53			13,918,650	148,854
Other species.....					38,232	2,117
Squid.....	13,800	309			6,134,557	108,894
Blackfish.....					40,000	40
Porpoise.....					750	15
Clams:						
Hard—						
Public.....	36,700	12,183			1,853,304	271,342
Private.....					22,640	12,425
Soft—						
Public.....	1,146,100	122,885	246,000	26,519	2,062,630	232,194
Private.....					125,000	10,750
Razor.....					23,300	3,300
Oysters:						
Market—						
Public.....	3,584	833			65,579	1,383
Private.....	23,275	7,387			769,055	278,164
Seed—						
Public.....	23,103	1,320			23,100	1,330
Private.....	11,200	640			90,178	6,552
Scallops.....	381,450	145,104			1,332,486	430,382
Cockles.....	275,000	1,050			577,400	3,425
Crabs:						
Hard.....	8,000	165	1,730,319	48,310	11,764,961	49,424
Soft.....	205	40			13,266	40
Lobsters.....	575,829	110,580	71,385	21,415	2,387,636	516,393
Shrimp.....					3,400	1,589
Tongues.....					600	12
Spaw n.....			52,360	3,834	146,929	8,876
Livers.....			30,550	477	313,575	4,844
Sperm oil.....					11,545,413	218,111
Ambergris.....	6,400	3,200			30	5,000
Alewife scales.....					10,400	5,200
Irish moss.....	178,700	13,115			204,200	15,027
Total.....	5,186,689	471,639	78,454,828	2,738,215	246,951,241	10,859,746

¹ 106,663 bushels.² 2,830 bushels.³ 206,263 bushels.⁴ 12,500 bushels.⁵ 2,330 bushels.⁶ 797 bushels.⁷ 109,865 bushels.⁸ 3,300 bushels.⁹ 11,454 bushels.¹⁰ 222,081 bushels.¹¹ 57,740 bushels.¹² 5,204,833 in number.¹³ 798 in number.¹⁴ 206,055 gallons.

FISHERIES BY APPARATUS.

The combined yield of all forms of apparatus employed in both the vessel and shore fisheries of Massachusetts in 1919 amounted to 246,951,241 pounds, valued at \$10,859,746. Lines were the most

productive form, yielding 108,703,430 pounds, valued at \$4,311,755, the principal species taken being: Cod, 62,604,055 pounds, valued at \$2,699,786; haddock, 33,154,060 pounds, valued at \$945,599; halibut, 1,649,305 pounds, valued at \$285,860; hake, 3,436,229 pounds, valued at \$130,755; and pollock, 4,698,115 pounds, valued at \$116,328. Otter trawls ranked second, with 58,584,932 pounds, valued at \$1,906,360, of which 42,593,223 pounds, valued at \$1,195,092, were haddock. Gill nets, employed chiefly in the taking of mackerel, pollock, haddock, and cod, yielded 18,204,216 pounds, valued at \$814,940. The catch with seines amounted to 14,159,335 pounds, valued at \$792,721. The most important species taken in seines was mackerel, the catch of which amounted to 8,552,827 pounds, valued at \$738,220. Various species were taken in pound nets, trap nets, and weirs to the amount of 32,314,809 pounds, valued at \$655,005. Other important forms of apparatus used in both the vessel and shore fisheries were dredges, with 2,023,428 pounds of oysters, scallops, and clams, valued at \$680,331; tongs, rakes, hoes, and forks, with 3,387,906 pounds of oysters, scallops, clams, and Irish moss, valued at \$577,203; and lobster pots with 4,152,597 pounds of lobsters and crabs, valued at \$565,817.

The following tables give the products of the vessel and shore fisheries by counties, apparatus, and species:

YIELD OF VESSEL FISHERIES OF MASSACHUSETTS IN 1919, BY COUNTIES, APPARATUS, AND SPECIES.

Apparatus and species.	Barnstable.		Bristol.		Dukes.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Otter trawls:						
Cod—Fresh.....	1,260	\$60	650	\$25		
Flounders.....	2,888,935	110,022	92,000	4,800	243,420	\$12,805
Haddock—Fresh.....	220	13				
Hake.....	385	5	80	2		
Pollock—Fresh.....			120	4		
Scallops.....			300	200		
Total.....	2,890,800	110,100	93,150	5,031	243,420	12,805
Lines:						
Catfish and wolffish.....	7,364	235				
Cod—Fresh.....	3,012,246	94,045	174,325	10,575	155,928	12,592
Cusk—Fresh.....	12,295	382				
Flounders.....	12,178	434				
Haddock—Fresh.....	5,224,160	151,401			64,000	4,480
Hake—Fresh.....	207,258	7,232	350	25	15,000	1,500
Halibut—Fresh.....	9,107	2,681	20,000	5,000		
Pollock—Fresh.....	229,186	4,895				
Rosefish.....	305	9				
Tautog.....			4,125	450		
Tilefish.....			38,000	1,330		
Spawn.....	37,107	1,601				
Total.....	8,751,206	262,915	236,800	17,380	234,928	18,572
Seines:						
Butterfish.....	248	29				
Cod.....	12,371	358				
Cusk.....	1,030	21				
Flounders.....	4,668	164				
Haddock.....	2,990	83				
Hake.....	5,450	202				
Herring.....	513,600	9,158				
Mackerel, fresh.....	1,616,538	126,082	127,500	13,750	37,500	4,950
Pollock.....	53,470	1,579				
Smelt.....	257	38				
Total.....	2,210,622	137,714	127,500	13,750	37,500	4,950

YIELD OF VESSEL FISHERIES OF MASSACHUSETTS IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

Apparatus and species.	Barnstable.		Bristol.		Dukes.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Gill nets:						
Mackerel.....	248, 748	\$27, 397	92, 900	\$7, 890	218, 330	\$27, 890
Total.....	248, 748	27, 397	92, 900	7, 890	218, 330	27, 890
Harpoons: Swordfish.....	112, 935	20, 860	103, 741	22, 265	106, 038	23, 130
Whaling gear:						
Ambergris.....	30	5, 000				
Sperm oil.....	678, 375	92, 450	867, 038	125, 661		
Total.....	678, 405	97, 450	867, 038	125, 661		
Lobster pots: Lobsters.....	1, 200	400	2, 740	685	18, 682	3, 228
Dredges:						
Clams, hard.....	4, 800	1, 200				
Oysters—						
Market, private.....	356, 685	142, 040	21, 000	5, 250		
Seed, private.....	17, 290	1, 482				
Scallops.....	68, 610	22, 375			2, 400	1, 000
Total.....	447, 385	167, 097	21, 000	5, 250	2, 400	1, 000
Tongs and rakes: Clams, hard.....			2, 800	1, 050		
Grand total.....	15, 341, 301	\$23, 933	1, 550, 669	198, 962	\$61, 298	91, 565

Apparatus and species.	Essex.		Nantucket.		Plymouth.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Otter trawls:						
Butterfish.....	330	\$23				
Catfish and wolffish.....	4, 616	312				
Cod—						
Fresh.....	2, 494, 530	107, 285	41, 000	\$2, 050		
Salted.....	40, 000	2, 200				
Cusk—						
Fresh.....	24, 765	892				
Salted.....	15, 000	675				
Flounders.....	1, 170, 280	47, 147	336, 000	26, 880		
Haddock—						
Fresh.....	8, 326, 644	234, 134	1, 000	50		
Salted.....	194, 000	6, 790				
Hake.....	32, 658	1, 338				
Halibut.....	13, 622	2, 316				
Hallock—						
Fresh.....	443, 280	10, 638				
Salted.....	14, 045	456				
Rosefish.....	9, 140	229				
Whiting.....	445	4				
Total.....	12, 792, 355	414, 439	378, 000	28, 080		
Lines:						
Catfish and wolffish.....	42, 237	1, 136				
Cod—						
Fresh.....	34, 344, 909	1, 479, 211				
Salted.....	3, 097, 105	160, 252				
Cusk—						
Fresh.....	821, 692	28, 627				
Salted.....	1, 570	84				
Flounders.....	6, 016	213				
Haddock—						
Fresh.....	14, 653, 310	410, 530				
Salted.....	179, 574	10, 206				
Hake—						
Fresh.....	1, 258, 021	50, 721				
Salted.....	29, 095	1, 307				
Halibut—						
Fresh.....	1, 416, 132	245, 904				
Salted.....	8, 045	1, 060				
Pollock—						
Fresh.....	1, 503, 661	36, 792				
Salted.....	27, 258	883				
Rosefish.....	3, 470	124				
Sharks.....	1, 118	28				
Skates.....	20	1				

YIELD OF VESSEL FISHERIES OF MASSACHUSETTS IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

Apparatus and species.	Essex.		Nantucket.		Plymouth.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Lines—Continued.						
Tilefish.....	116,670	\$7,000				
Livers.....	2,225	38				
Spawn.....	54,750	3,255				
Total.....	57,567,978	2,437,372				
Seines:						
Bonito.....	300	30				
Butterfish.....	40	4				
Cod.....	5,900	254				
Haddock.....	1,025	29				
Hake.....	3,318	136				
Herring.....	556,112	6,105				
Mackerel—						
Fresh.....	4,788,267	400,778	2,000	\$200		
Salted.....	1,249,062	109,948				
Pollock.....	2,095,253	46,863				
Shad.....	822	138				
Sharks.....	180	11				
Spawn.....	1,100	58				
Total.....	8,701,379	564,354	2,000	200		
Gill nets:						
Bonito.....	280	15				
Butterfish.....	1,060	58				
Cod.....	1,241,606	50,195				
Haddock.....	2,019,379	55,729				
Hake.....	194,641	7,988				
Mackerel.....	1,391,665	181,983	24,000	2,400		
Pollock.....	9,217,089	229,255				
Rosefish.....	825	33				
Shad.....	7,800	153				
Sharks.....	100	1				
Skates.....	30	1				
Shrimp.....	300	39				
Livers.....	195,650	3,053				
Spawn.....	30	1				
Total.....	14,270,455	528,504	24,000	2,400		
Harpoons: Swordfish.....	275,502	64,951	1,300	214		
Dredges:						
Clams, hard.....			132,000	39,050		
Scallops.....			8,700	3,500	4,680	\$1,320
Total.....			140,700	42,550	4,680	1,320
Tongs and rakes: Clams, hard.....			4,800	1,800		
Grand total.....	93,607,669	4,009,620	550,800	76,144	4,680	1,320

Apparatus and species.	Suffolk.		Total.	
	Pounds.	Value.	Pounds.	Value.
Otter trawls:				
Butterfish.....	21,549	\$1,782	21,879	\$1,805
Catfish and wolfish.....	62,671	1,647	67,287	1,959
Cod—				
Fresh.....	2,453,117	105,491	4,990,557	214,911
Salted.....			40,000	2,200
Cusk—				
Fresh.....	6,550	236	31,315	1,128
Salted.....			15,000	675
Eels.....	490	7	490	7
Flounders.....	1,062,262	47,269	5,801,897	248,923
Haddock—				
Fresh.....	34,057,878	953,728	42,385,742	1,187,925
Salted.....			194,000	6,790
Hake.....	397,579	16,298	430,702	17,643
Halibut.....	53,627	9,116	67,249	11,432
Pollock—				
Fresh.....	311,442	7,475	754,842	18,117
Salted.....			14,045	456
Rosefish.....	2,405	90	11,545	319
Shad.....	7	1	7	1
Sharks.....	990	52	990	52

YIELD OF VESSEL FISHERIES OF MASSACHUSETTS IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

Apparatus and species.	Suffolk.		Total.	
	Pounds.	Value.	Pounds.	Value.
Otter trawls—Continued.				
Skates.....	1,810	\$39	1,810	39
Sturgeon.....	1,335	264	1,335	264
Whiting.....			445	
Scallops.....			300	50
Total.....	38,433,712	1,143,495	54,831,437	1,714,590
Lines:				
Catfish and wolfish.....	15,509	454	65,110	1,525
Cod—				
Fresh.....	15,189,656	653,053	52,877,064	2,249,475
Salted.....			3,097,905	100,232
Cusk—				
Fresh.....	358,353	12,890	1,192,340	41,809
Salted.....			1,870	51
Flounders.....	15,909	646	34,103	1,285
Haddock—				
Fresh.....	10,467,834	293,006	30,409,304	858,417
Salted.....			179,574	10,206
Hake—				
Fresh.....	884,876	36,202	2,365,505	95,680
Salted.....			29,095	1,307
Hallbut—				
Fresh.....	178,280	28,231	1,623,519	281,816
Salted.....			8,045	1,030
Pollock—				
Fresh.....	1,536,431	37,447	3,289,278	74,134
Salted.....			27,258	883
Rosefish.....	11,078	430	14,853	661
Sharks.....	115	2	1,243	30
Skates.....			20	1
Tautog.....			4,125	49
Tilfish.....	33,510	1,473	188,180	9,505
Livers.....	2,250	51	4,475	139
Spawn.....	39,396	2,890	131,253	7,746
Total.....	28,753,197	1,066,775	95,544,109	3,810,014
Selnes:				
Alewives.....	800	8	800	8
Bonito.....	200	12	500	42
Butterfish.....	905	101	1,193	134
Cod.....	2,654	115	20,925	777
Cusk.....			1,080	21
Flounders.....			4,668	164
Haddock.....			4,015	112
Hake.....	670	27	9,438	365
Herring.....			1,069,712	15,285
Mackerel—				
Fresh.....	380,214	44,464	6,952,019	590,224
Salted.....			1,249,062	103,948
Pollock.....	644,845	15,476	2,793,568	63,918
Shad.....	10,060	600	10,822	738
Sharks.....			180	11
Smelt.....			237	8
Spawn.....			1,100	5
Total.....	1,040,285	60,803	12,119,289	781,771
Gill nets:				
Bonito.....			280	35
Butterfish.....			1,060	55
Cod.....	129,075	5,530	1,370,681	55,745
Haddock.....	384,285	10,760	2,403,665	66,429
Hake.....	15,080	619	209,731	8,607
Mackerel.....	273,692	32,296	2,248,735	279,856
Pollock.....	1,310,981	31,464	10,528,070	230,719
Rosefish.....			825	33
Shad.....			7,800	153
Sharks.....			100	1
Skates.....			30	1
Shrimp.....			300	30
Livers.....	28,300	426	223,950	3,479
Spawn.....			30	1
Total.....	2,140,824	81,115	16,995,257	675,196
Harpoons: Swordfish.....	91,313	20,700	693,829	132,110

YIELD OF VESSEL FISHERIES OF MASSACHUSETTS IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

Apparatus and species.	Suffolk.		Total.	
	Pounds.	Value.	Pounds.	Value.
Whaling gear:				
Ambergris.....			30	\$5.000
Sperm oil.....			1,545,413	218,111
Total.....			1,545,443	223,111
Lobster pots: Lobsters.....			22,622	4,313
Dredges:				
Clams, hard.....			136,800	40,269
Oysters—				
Market, private.....			377,685	147,290
Seed, private.....			17,290	1,482
Scallops.....			84,390	28,195
Total.....			616,165	217,217
Tongs and rakes: Clams, hard.....			7,600	2,850
Grand total.....	79,459,334	\$2,372,888	182,375,751	7,574,432

YIELD OF SHORE FISHERIES OF MASSACHUSETTS IN 1919, BY COUNTIES, APPARATUS, AND SPECIES.

BY POUND NETS, TRAPS, WEIRS, DREDGES, OTTER TRAWLS, GILL NETS DIP NETS, AND SEINES.

Apparatus and species.	Barnstable.		Bristol.		Dukes.		Essex.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Pound nets, trap nets, and weirs.....								
Alewives—								
Fresh.....	194,566	\$3,484	77,795	\$1,549	96,050	\$1,706	17,315	\$244
Salted.....	35,000	1,750			140,000	6,300		
Bluefish.....	3,932	696			121	24	668	71
Bonito.....	33,956	2,549	40	4	95,461	9,929	90	9
Butterfish.....	176,061	14,966	11,760	850	56,899	5,853	19,029	2,641
Catfish and wolfish.....							14	1
Cod.....	113,668	4,822	795	37	81	6	173,006	5,400
Cunners.....							2,809	85
Eels.....	3,850	455	4,500	450				
Flounders.....	161,086	7,828	19,753	1,017	13,043	1,162	1,805	58
Frigate mackerel.....					61,361	1,802		
Grayfish.....	1,000	10	62,667	174				
Gooselish.....			2,500	7				
Haddock.....	2,631	13			554	33	2,295	63
Hake.....	395	4	183	3	86	1	4,810	110
Herring.....	5,931,481	71,121	88,765	1,373	25	3	1,321,184	17,285
Hickory shad.....	11,650	780	1,150	50				
Kingfish.....			72	18				
Launce.....	3,800	38						
Mackerel.....	1,419,313	148,182	28,605	2,871	55,007	5,035	122,885	13,034
Menhaden.....	69,303	1,605	49,516	272	5,409	54		
Perch, white.....					6,000	900		
Pollock.....	103,725	3,135	20	1	2,371	113	185,792	3,243
Pompano.....	14	2						
Round herring.....	941	19						
Sculpin.....			6,000	15				
Scup.....	8,634	494	52	6	63,578	4,393		
Sea bass.....			2,289	50	3,865	532	18	2
Sea robin.....			490	1				
Shad.....	5,645	1,553	54	17	37	7	435	47
Sharks.....	11,300	183	3,175	71			3,000	75
Skates and rays.....			93,649	381				
Smelt.....			97	13				
Squeteague.....	613	74	962	151	4,202	683		
Striped bass.....	287	110	605	103	59	13		
Sturgeon.....	5,183	1,191					180	22
Sturgeon caviar.....	30	85						
Sturgeon roe.....	175	150					6	13
Tanlog.....	23,627	1,362	13,519	1,516	222	19	158	6
Tomcod.....	2,299	6	2,390	93				
Tuna.....	37,048	2,716	53	2			5,000	750
Whiting.....	11,173,383	135,483	57,709	948	62,727	365	2,563,780	11,339

YIELD OF SHORE FISHERIES OF MASSACHUSETTS IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

BY POUND NETS, TRAPS, WEIRS, DREDGES, OTTER TRAWLS, GILL NETS, DIP NETS, AND SEINES—Continued.

Apparatus and species.	Barnstable.		Bristol.		Dukes.		Essex.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Pound nets, trap nets, and weirs—Continued.								
Other species.....	9,500	\$100	8,411	\$388	20,321	\$1,629		
Squid.....	5,837,988	104,364	141,129	2,184	16,459	253	121,831	\$1,671
Porpoise.....	750	15						
Total.....	25,382,735	509,347	675,555	14,406	703,929	40,875	4,546,068	55,569
Dredges:								
Clams, hard.....	4,800	1,800						
Oysters, market, private.....	138,915	52,237						
Scallops.....	397,656	114,328	42,000	14,000	298,620	87,325		
Total.....	541,371	168,365	42,000	14,000	298,620	87,325		
Otter trawls:								
Cod.....							450	19
Flounders.....	891,315	41,712	69,000	2,800	639,275	44,490	713,567	30,798
Rosefish.....							6,715	301
Scup.....					1,000	180		
Sea bass.....					6,000	600		
Total.....	891,315	41,712	69,000	2,800	646,275	45,270	720,732	30,918
Gill nets:								
Butterfish.....	247	44					149,788	7,702
Cod.....							4,500	135
Flounders.....							15,000	810
Haddock.....							7,200	265
Herring.....							362,428	35,506
Mackerel.....	296,925	30,304	10,500	1,500	13,500	2,125	1,800	64
Pollock.....							5,196	204
Sharks.....							2,000	19
Skates.....							900	81
Sturgeon.....								
Total.....	267,173	30,348	10,500	1,500	13,500	2,125	551,812	44,707
Dip nets:								
Alewives—								
Fresh.....	14,400	396						
Salted.....	240,000	8,400						
Flounders.....							500	25
Herring.....							152,950	4,268
Perch, yellow.....							500	25
Scallops.....	34,950	8,800						
Total.....	289,350	17,596					153,950	4,318
Seines:								
Alewives—								
Fresh.....	63,000	1,279	27,000	535	455,100	12,435	12,500	100
Salted.....	364,600	19,190	60,534	2,220				
Smoked.....	2,000	150						
Butterfish.....	700	105						
Cod.....	3,000	120						
Eels.....					21,000	1,200	71,270	1,981
Herring.....	360	5					203,662	1,762
Launce.....	64,000	809						
Mackerel.....	43,100	5,617	235	40	10,000	1,200	288,211	30,506
Minnows.....	1,000	125						
Pollock.....							159,036	3,817
Shad.....			298	68			24,309	959
Shrimp.....	3,100	1,550						
Alewife scales.....	3,000	1,500						
Total.....	547,860	30,441	88,067	2,833	486,100	14,835	758,988	39,122

YIELD OF SHORE FISHERIES OF MASSACHUSETTS IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

BY POUND NETS, TRAPS, WEIRS, DREDGES, OTTER TRAWLS, GILL NETS, DIP NETS, AND SEINES—Continued.

Apparatus and species.	Nantucket.		Plymouth.		Suffolk.		Total.	
Pound nets, trap nets, and weirs:								
Alewives—								
Fresh.....	Pounds. 16,400	Value. \$164	Pounds. 80,050	Value. \$674	Pounds.	Value.	Pounds. 482,176	Value. \$7,812
Salted.....	27,000	1,080	230,000	9,775			432,000	18,905
Bluefish.....							4,721	791
Bonito.....	59,400	5,470					188,947	17,961
Butterfish.....			4,775	517			268,474	24,227
Catfish and wolfish.....							14	1
Cod.....	1,400	70					288,950	10,335
Cunners.....							2,809	85
Eels.....							8,350	905
Flounders.....	4,210	530					199,897	10,595
Frigate mackerel.....							61,361	1,862
Grayfish.....							63,667	184
Goosefish.....							2,500	7
Haddock.....							5,421	109
Hake.....							5,474	118
Herring.....	2,000	300	406,600	4,464			7,750,055	94,546
Hickory shad.....							12,800	830
Kingfish.....							72	18
Launce.....							3,800	38
Mackerel.....	63,700	5,325	8,687	803			1,698,198	175,250
Menhaden.....							121,219	1,931
Perch, white.....							6,000	900
Pollock.....	900	36					292,808	6,528
Pompano.....							14	2
Round herring.....							911	19
Sculpin.....							6,000	15
Scup.....	2,450	245					74,714	5,138
Sea bass.....	2,000	300					8,172	884
Sea robin.....							400	1
Shad.....	12,800	750					18,971	2,374
Sharks.....							17,475	329
Skates and rays.....							93,649	381
Smelt.....							97	13
Squeteague.....							5,777	908
Striped bass.....							951	226
Sturgeon.....							5,363	1,213
Sturgeon caviar.....							30	85
Sturgeon roe.....							181	163
Tautog.....							37,526	2,703
Tomcod.....							4,590	99
Tuna.....							42,101	3,468
Whiting.....	53,600	660	7,000	53			13,918,205	148,850
Other species.....							38,232	2,117
Squid.....	3,350	83	13,800	309			6,134,557	108,864
Porpoise.....							750	15
Alewife scales.....			6,400	3,200			6,400	3,200
Total.....	249,210	15,013	757,312	19,795			32,314,809	655,005
Dredges:								
Clams, hard.....							4,800	1,800
Oysters—								
Market—								
Public.....			175	63			175	63
Private.....			16,275	4,887			155,190	57,124
Seed—								
Public.....			23,100	1,320			23,100	1,320
Private.....			11,200	640			11,200	640
Scallops.....	94,752	42,730	379,770	143,784			1,212,798	402,167
Total.....	94,752	42,730	430,520	150,694			1,407,263	463,114
Otter trawls:								
Catfish and wolfish.....					125	\$3	125	5
Cod.....	20,000	900			7,219	310	27,669	1,229
Flounders.....	271,000	21,680	25,000	1,000	1,082,298	16,252	3,691,455	188,732
Haddock.....					13,481	377	13,481	377
Hake.....					3,958	172	3,958	172
Pollock.....					257	6	257	6
Rosefish.....					2,835	108	9,550	209
Scup.....							1,000	180
Sea bass.....							6,000	600
Total.....	291,000	22,580	25,000	1,000	1,110,173	47,230	3,753,495	191,510

YIELD OF SHORE FISHERIES OF MASSACHUSETTS IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

BY POUND NETS, TRAPS, WEIRS, DREDGES, OTTER TRAWLS, GILL NETS, DIP NETS, AND SEINES—Continued.

Apparatus and species.	Nantucket.		Plymouth.		Suffolk.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Gill nets:								
Butterfish.....							247	\$44
Cod.....			700	\$38			150,488	7,740
Flounders.....							4,500	135
Haddock.....							18,000	810
Herring.....			4,000	55			11,200	260
Mackerel.....			30,000	4,500	325,724	\$54,304	1,009,078	128,239
Pollock.....							1,800	54
Shad.....					130	16	130	16
Sharks.....							5,196	204
Skates.....							2,000	10
Sturgeon.....	4,500	\$1,800					5,400	1,881
Sturgeon caviar.....	120	271					120	271
Tuna.....			800	80			800	80
Total.....	4,620	2,071	35,500	4,673	325,854	54,320	1,208,959	139,744
Dip nets:								
Alewives—								
Fresh.....							14,400	306
Salted.....							240,000	8,400
Flounders.....							500	25
Herring.....			1,400,000	7,000	115,670	3,070	1,668,620	14,338
Perch, yellow.....							500	25
Crabs, soft.....			266	40			266	40
Scallops.....							34,950	8,800
Total.....			1,400,266	7,040	115,670	3,070	1,959,236	32,024
Seines:								
Alewives—								
Fresh.....			1,000	30			558,600	14,379
Salted.....							425,134	21,410
Smoked.....							2,000	150
Butterfish.....					31	4	731	109
Cod.....							3,000	120
Eels.....							92,270	3,181
Herring.....					107,800	3,234	311,822	5,091
Launce.....							64,000	800
Mackerel.....			10,200	688			351,746	38,048
Menhaden.....			40,000	300			40,000	300
Minnnows.....							1,000	125
Pollock.....							159,036	3,817
Shad.....							24,607	1,027
Shrimp.....							3,100	1,550
Alewife scales.....							3,000	1,500
Total.....			51,200	1,018	107,831	3,238	2,040,046	91,517

BY LINES, TONGS, RAKES, HOES, FORKS, EEL POTS, LOBSTER POTS, AND SPEARS.

Apparatus and species.	Barnstable.		Bristol.		Dukes.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Lines:						
Butterfish.....	3,244	\$433				
Catfish and wolfish.....	13,612	95				
Cod—						
Fresh.....	2,989,827	129,802	1,100	\$60	45,250	\$1,715
Salted.....	6,500	450				
Cusk.....	3,103	33				
Eels.....			625	100		
Flounders.....	14,700	1,047	3,170	260	17,500	1,000
Haddock.....	635,916	20,846			1,000	40
Hake.....	431,414	8,396	2,150	150		
Halibut.....	10,211	1,704				
Mackerel.....	2,226	197	3,705	475	1,000	120
Pollock—Fresh.....	856,526	20,140			43,500	1,285
Scup.....	1,710	265			700	53
Sea bass.....	345	110			500	50
Sharks.....	303,225	3,037				
Skates.....	885	17				
Striped bass.....	20	5				
Tanog.....	11,800	1,227	28,725	3,655	600	30
Livers.....	150	1				
Total.....	5,285,504	187,805	39,475	4,700	110,050	4,293

YIELD OF SHORE FISHERIES OF MASSACHUSETTS IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

BY LINES, TONGS, RAKES, HOES, FORKS, EEL POTS, LOBSTER POTS, AND SPEARS—Continued.

Apparatus and species.	Barnstable.		Bristol.		Dukes.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Tongs, rakes, hoes, and forks:						
Clams—						
Hard—						
Public.....	281,520	\$95,523	192,560	\$62,550	79,120	\$27,300
Private.....	22,640	12,425				
Soft—						
Public.....	136,000	13,189	6,000	900	5,000	875
Private.....	125,000	10,750				
Razor.....	23,300	3,500				
Oysters, market—						
Public.....	875	150	1,120	400		
Private.....	228,235	71,120	945	130		
Scallops.....	45	20				
Total.....	817,618	206,677	200,625	63,980	84,120	28,175
Eel pots: Eels.....	62,443	7,874	2,253	180	18,500	2,305
Lobster pots: Lobsters.....	98,220	26,588	253,878	53,717	591,815	101,382
Spears:						
Eels.....	13,235	2,006	6,800	1,200		
Flounders.....	6,900	575				
Total.....	20,135	2,581	6,800	1,200		

Apparatus and species.	Essex.		Nantucket.		Norfolk.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Lines:						
Catfish and wolffish.....	17,369	\$542				
Cod—						
Fresh.....	1,039,538	45,643	130,000	\$5,100	22,000	\$1,760
Salted.....			30,000	3,600		
Cusk.....	226,711	8,162				
Eels.....	1,790	225				
Flounders.....	266,058	15,410			8,000	800
Haddock.....	448,187	13,504	15,100	458	500	40
Hake.....	463,722	19,308				
Halibut.....	6,081	1,034				
Mackerel.....	425	52				
Pollock—						
Fresh.....	350,848	10,580	27,500	1,450	1,000	80
Salted.....	8,850	435				
Skates.....	1,460	44				
Smelt.....	7,796	1,864			22,200	6,425
Tautog.....					2,000	180
Tongues.....	600	12				
Spawn.....	1,582	87				
Livers.....	85,000	1,275				
Total.....	2,926,017	118,177	202,600	10,608	55,700	9,285
Tongs, rakes, hoes, and forks:						
Clams—						
Hard—Public.....	600	75	111,144	27,986		
Soft—Public.....	460,660	58,206			63,470	9,620
Irish moss.....					25,500	1,912
Total.....	460,660	58,281	111,144	27,986	88,970	11,532
Eel pots: Eels.....	32,025	6,190	30,000	4,500	1,000	130
Lobster pots:						
Lobsters.....	677,387	161,249	19,446	8,759	77,054	19,390
Crabs, hard.....	18,167	395			18,475	554
Total.....	695,554	161,644	19,446	8,759	95,529	19,944
Spears: Eels.....	8,906	1,781			2,000	400

YIELD OF SHORE FISHERIES OF MASSACHUSETTS IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

BY LINES, TONGS, RAKES, HOES, FORKS, EEL POTS, LOBSTER POTS, AND SPEARS—Continued.

Apparatus and species.	Plymouth.		Suffolk.		Total.	
Lines:	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Butterfish.....					3,244	\$483
Catfish and wolfish.....			127,671	\$84,792	158,632	8,429
Cod—						
Fresh.....	181,413	\$7,888	2,182,458	93,840	6,591,586	285,808
Salted.....	1,600	200			37,500	4,250
Cusk.....	3,000	84	103,838	3,741	336,652	12,020
Eels.....					2,415	324
Flounders.....	17,700	994	188,355	8,716	515,573	26,227
Harddock.....	4,750	183	1,439,729	40,905	2,665,182	75,976
Hake.....	3,100	125	141,243	5,789	1,041,629	35,768
Halibut.....			1,449	246	17,741	2,984
Mackerel.....					7,356	841
Pollock—						
Fresh.....	15,600	474	77,755	1,867	1,372,729	35,876
Salted.....					8,850	435
Scup.....	500	30			2,910	948
Sea bass.....	50	5			895	165
Sharks.....					303,225	3,037
Skates.....			500	10	2,845	71
Smelt.....	7,500	2,025	1,300	325	38,796	10,639
Striped bass.....					20	6
Tautog.....	7,100	640			50,225	5,772
Tomcod.....			1,000	50	1,000	50
Tongues.....					600	12
Spawn.....			12,964	944	14,546	1,051
Livers.....					85,150	1,576
Total.....	241,713	12,648	4,298,262	161,225	13,159,321	508,741
Tongs, rakes, hoes, and forks:						
Clams—						
Hard—						
Public.....	35,960	11,933			700,904	225,367
Private.....					22,640	12,425
Soft—						
Public.....	1,146,100	122,885	246,000	26,519	2,062,680	232,194
Private.....					125,000	10,750
Razor.....					20,300	3,500
Oysters, market—						
Public.....	3,400	770			5,404	1,320
Private.....	7,000	2,500			236,180	73,750
Scallops.....					48	20
Irish inoss.....	178,700	13,115			204,200	15,627
Total.....	1,371,169	151,203	246,000	26,519	3,380,306	574,353
Eel pots: Eels.....	9,200	1,148			155,421	22,327
Lobster pots:						
Lobsters.....	575,829	119,580	71,385	21,415	2,565,014	512,080
Crabs, hard.....	8,000	165	1,720,319	48,310	1,764,961	49,424
Total.....	583,829	119,745	1,791,704	69,725	4,129,975	561,504
Spears:						
Eels.....	500	55			81,441	3,442
Flounders.....					6,900	375
Total.....	500	55			38,341	6,017

YIELD OF SHORE FISHERIES OF MASSACHUSETTS IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

BY BOW NETS, FYKE NETS, HARPOONS, COCKLE TRAPS, AND CUNNER TRAPS.

Apparatus and species.	Barnstable.		Bristol.		Dukes.		Essex.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Bow nets: Alewives—										
Fresh.....	41,500	\$475							41,500	\$475
Salted.....	162,000	7,280							162,000	7,280
Smoked.....	37,000	2,695							37,000	2,695
Seales.....	1,000	500							1,000	500
Total.....	241,500	10,950							241,500	10,950
Fyke nets:										
Eels.....	33,180	6,577	10,600	\$950	40,000	\$8,000			83,780	15,527
Flounders.....			3,200	181					3,200	181
Perch, white.....			200	20					200	20
Tomcod.....			2,300	90					2,300	90
Total.....	33,180	6,577	16,300	1,241	40,000	8,000			89,480	15,818
Harpoons: Swordfish.....			2,400	600	15,500	2,620			17,900	3,220
Cockletraps: Cockles.....	1,450	725					300,000	\$1,350	301,450	2,075
Cunner traps: Cunnere.....			7,150	500					7,150	500

WITHOUT APPARATUS.

Species.	Barnstable.		Plymouth.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Blackfish.....	40,000	\$40			40,000	\$40
Clams, hard.....	2,400	825	800	\$250	3,200	1,075
Oysters, seed, private.....	51,688	4,430			51,688	4,430
Cockles.....	950	300	275,000	1,050	275,950	1,350
Total.....	95,038	5,595	275,800	1,300	370,838	6,895

INDUSTRIES.

Wholesale fishery trade.—In 1919 there were 139 wholesale fishery establishments in Massachusetts, valued at \$2,928,405, with a cash capital amounting to \$1,522,545, in which 1,468 persons were engaged, to whom \$1,790,495 were paid in wages.

Five of these firms engaged in the manufacture of oil and fertilizer incidental to their wholesale business. The quantity of fish oil manufactured amounted to 56,250 gallons, valued at \$60,147, and of fertilizer to 324,750 pounds, valued at \$2,000.

Smoked, canned, and by-product industries.—In the appended table the statistics of the smoked, canned, and by-product industries of Massachusetts in 1919 are shown in detail. The quantity of fish smoked, salted, and pickled amounted to 12,807,782 pounds, valued at \$863,927, the principal items being finnan haddie, 4,506,216 pounds, valued at \$352,692, and salted and pickled herring, 3,299,950 pounds, valued at \$100,530. The pack of canned products amounted to 52,474 cases, valued at \$362,926, and the value of the by-products was \$1,050,317.

INDUSTRIES OF MASSACHUSETTS IN 1919.

Item.	Smoked fish, and salted and pickled herring.		Canned.		By-products.		Total.	
	Number.	Value.	Number.	Value.	Number.	Value.	Number.	Value.
Plants.....	¹ 16	\$694,688	6	\$1,513,725	² 12	\$447,389	34	\$2,655,802
Cost of materials.....		139,644		654,079				
Cash capital.....		122,500		154,500		122,400		399,400
Persons engaged.....	365		1,490		331		2,186	
Wages paid.....		332,979		1,082,065		428,929		1,843,973
MANUFACTURED PRODUCTS.								
Liver and menhaden oil...gallons.....					³ 207,627	236,110	207,627	236,110
Liquid glue...do.....					⁴ 388,252	474,924	388,252	474,924
Fish scrap and fertilizer...pounds.....					14,895,358	339,283	14,895,358	339,283
Kippered herring, pounds.....	233,378	28,440					233,378	28,440
Finnan haddie, pounds.....	4,506,216	352,692					4,506,216	352,692
Smoked herring: Plain and Bismarks, pounds.....	3,045,400	201,550					3,045,400	201,550
Bloaters...do.....	1,290,600	131,350					1,290,600	131,350
Smoked alewives, halibut, salmon, and sharks, pounds.....	432,238	49,365					432,238	49,365
Salted and pickled herring...pounds.....	3,299,950	100,530					3,299,950	100,530
Clams (various sizes)...cases.....			12,340	72,089			12,340	72,089
Clam chowder and clam extract (various sizes)...cases.....			2,384	10,624			2,384	10,624
Miscellaneous species of fish (various sizes)...cases.....			⁵ 37,750	280,013			37,750	280,013
Total.....	12,807,782	803,927	52,474	362,926		1,050,317		2,277,170

¹ Does not include two plants which are shown under canning industry.² Includes two menhaden plants operated in Connecticut.³ Includes small quantities of shark, blackfish, and porpoise oils.⁴ Includes a small quantity of dry glue.⁵ Includes "sardines," cod, haddock, herring, mackerel, whiting, and fish roe.

FISHERIES OF RHODE ISLAND.

Rhode Island ranked third among the New England States in 1919 in the investment, quantity, and value of its fishery products, and fourth in the number of persons engaged. The number of persons employed was 1,646, of whom 317 were on fishing vessels, 44 on vessels transporting fishery products, 795 in the shore and boat fisheries, and 490 shoresmen in the wholesale fish establishments.

The investment amounted to \$2,249,536 and included 82 fishing and transporting vessels, valued at \$392,164, with a net tonnage of 1,594 tons and outfits valued at \$168,235; 628 power, sail, row, and other small boats, valued at \$187,283; apparatus employed in the vessel and boat fisheries to the value of \$314,496; shore and accessory property valued at \$978,622, and working cash capital to the amount of \$209,300.

The products of the fisheries amounted to 48,250,883 pounds, valued at \$3,296,578. The five most important species, arranged in the order of their value, were: Oysters, 6,261,759 pounds, or 894,537 bushels, valued at \$1,242,585; scup, 8,261,140 pounds, valued at \$817,846; lobsters, 1,694,327 pounds, valued at \$360,679; menhaden,

21,536,000 pounds, valued at \$268,700, and mackerel, 1,575,923 pounds, valued at \$146,611.

Compared with 1905, there has been a decrease of 566 in the number of persons employed in the fisheries of the State, but an increase in the investment amounting to \$1,184,062, in the total quantity of products of 24,354,640 pounds and in the value of \$1,749,920. There was a large increase in the catch of the following species as compared with 1905: Menhaden, 20,509,800 pounds in quantity and \$265,678 in value; scup, 2,721,100 pounds in quantity and \$679,816 in value; whiting, 1,313,630 pounds in quantity and \$12,244 in value; flounders, 1,308,114 pounds in quantity and \$44,139 in value; lobsters, 1,053,873 pounds in quantity and \$296,321 in value; and mackerel,

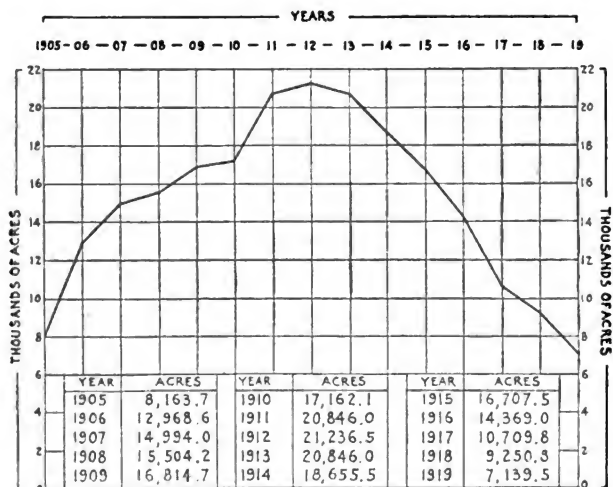


FIG. 9.—Acres of oyster ground leased to individuals in Rhode Island, by years, from 1905 to 1919, inclusive.

737,993 pounds in quantity and \$98,557 in value. The species for which there has been a significant decrease, with the amount of the decrease, follow: Squeteague, 2,868,925 pounds in quantity and \$52,649 in value; haddock, 505,435 pounds in quantity and \$14,276 in value; and alewives, 329,025 pounds in quantity and \$1,115 in value. No shad, hickory shad, or king whiting were reported in the catch in 1919. The take of Irish moss amounted to only 2,000 pounds, valued at \$240, in 1919, as compared with 16,000 pounds, valued at \$1,120, in 1905.

The accompanying graph (fig. 9), showing the number of acres of oyster ground leased to individuals in Rhode Island, by years, from 1905 to 1919, indicates with marked clearness the rise and fall in that State of its most important fishery. According to canvasses made by this Bureau, the yield in 1905 amounted to 916,088 bushels, in 1910 to 2,268,278 bushels, and in 1919 to 894,537 bushels, which substan-

tiates in a measure the general trend of the oyster industry as indicated by this graph.

Although the figures appearing in the appended table show the number of acres leased from the State, they do not represent the actual number of acres under cultivation during each year. From data secured in 1910 the number of acres under cultivation was 15,927.2, or 93 per cent of the total number leased during that year.

FISHERIES BY COUNTIES.

The statistics as to the number of persons employed, investment, and products of the fisheries in Rhode Island are given by counties in the following table:

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF FISHERIES OF RHODE ISLAND IN 1919, BY COUNTIES.

Items.	Bristol.		Kent.		Newport.	
	Number.	Value.	Number.	Value.	Number.	Value.
PERSONS ENGAGED.						
On vessels fishing.....	24		2		211	
On vessels transporting.....	1				33	
In shore fisheries.....	39		104		449	
Shoresmen.....	104		28		104	
Total.....	168		134		797	
INVESTMENT.						
Vessels fishing:						
Gasoline.....	7	\$25,300	1	\$3,500	30	\$92,200
Tonnage.....	113		13		406	
Outfit.....		12,481		1,200		46,874
Steam.....					7	124,000
Tonnage.....					277	
Outfit.....						45,950
Vessel transporting:						
Gasoline.....	1	1,000			6	16,000
Tonnage.....	10				55	
Outfit.....		100				4,600
Steam.....					5	22,000
Tonnage.....					77	
Outfit.....						23,800
Boats:						
Sail, row, etc.....	16	350	24	410	93	2,580
Power.....	22	6,175	76	20,065	229	117,290
Apparatus, vessel fisheries:						
Purse seines.....					18	24,695
Gill nets.....					780	14,445
Pound nets.....					25	75,000
Lines, hand and trawl.....						785
Otter trawls.....	1	45			14	688
Harpoons.....						561
Lobster pots.....					410	1,310
Dredges.....	14	620	2	75	4	130
Apparatus, shore fisheries:						
Seines.....	2	175			7	574
Gill nets.....					360	7,300
Pound nets and trap nets.....	6	1,800			75	70,350
Fyke nets.....			20	310	240	4,368
Dip nets.....					30	450
Lines, hand and trawl.....		42				4,185
Otter trawls.....					39	2,270
Harpoons.....						690
Lobster pots.....	321	1,030	146	413	15,942	47,610
Eel pots.....	480	530			60	85
Dredges.....	12	122	142	744	40	218
Tongs.....	21	185	92	743	58	583
Rakes.....	1	5	5	40	7	27
Hoes.....	12	12	54	54	7	7
Grabs.....					6	18
Shovels.....	10	10	11	11		
Winkle pots.....					260	880
Shore and accessory property.....		107,982		9,562		462,753
Cash capital.....		34,500		4,800		79,000
Total.....		192,464		41,927		1,294,276

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF FISHERIES OF RHODE ISLAND
IN 1919, BY COUNTIES—Continued.

Items.	Bristol.		Kent.		Newport.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
PRODUCTS.						
Alwives.....					260,550	\$5,736
Bluefish.....					21,345	2,485
Bonito.....					114,810	10,825
Butterfish.....	20,000	\$1,000			712,320	36,592
Cod.....					1,123,331	48,647
Cunner.....					8,000	960
Eels.....	67,450	7,042			131,730	14,075
Flounders.....	41,330	1,240	510	\$15	1,687,699	53,740
Haddock.....					10,300	512
Herring.....					144,550	3,509
Mackerel.....					1,531,423	141,689
Menhaden.....					21,536,000	268,700
Perch, white.....					5,043	702
Pollock.....					99,400	5,920
Scup.....					8,206,000	812,456
Sea bass.....					48,741	5,454
Squeteague.....					285,440	26,675
Swordfish.....					101,010	19,757
Tautog.....	30,780	1,561	280	15	274,825	15,275
Tuna.....					50,130	4,010
Whiting.....					1,405,200	14,140
Lobster.....	24,300	4,780	9,413	1,993	1,270,562	273,086
Crabs.....					26,000	1,300
Squid.....					180,265	8,065
Clams:						
Hard.....	5,560	2,130	49,944	18,845	34,544	13,106
Soft.....	15,290	919	108,120	6,432	23,160	1,268
Scallops.....	400	200	31,074	13,125	2,016	1,032
Mussels.....					10,000	1,000
Winkles.....					10,500	2,100
Oysters, market, private.....	1,481,942	282,592	81,508	16,124	56,700	11,472
Irish moss.....					2,000	240
Total.....	1,687,052	301,164	280,849	56,549	39,373,594	1,804,528

Items.	Providence.		Washington.		Total.	
	Number.	Value.	Number.	Value.	Number.	Value.
PERSONS ENGAGED.						
On vessels fishing.....	55		25		317	
On vessels transporting.....	2		8		44	
In shore fisheries.....	73		130		795	
Shoresmen.....	231		23		490	
Total.....	361		186		1,646	
INVESTMENT.						
Vessels fishing:						
Gasoline.....	7	\$52,000	10	\$26,400	55	\$199,400
Tonnage.....	229		88		849	
Outfit.....		13,520		7,050		82,025
Steam.....	2	17,000			9	141,000
Tonnage.....	87				564	
Outfit.....		5,960				51,910
Vessels transporting:						
Gasoline.....	1	1,200	5	11,000	13	29,200
Tonnage.....	5		34		104	
Outfit.....		1,400		4,400		10,500
Steam.....					5	22,000
Tonnage.....					77	
Outfit.....						23,800
Boats:						
Sail, row, etc.....	29	483	34	680	196	4,503
Power.....	21	4,575	84	34,675	432	182,780
Apparatus, vessel fisheries:						
Purse seines.....					18	24,695
Gill nets.....					780	14,445
Pound nets.....					25	75,000
Lines, hand and trawl.....						785
Otter trawls.....			5	240	20	973
Harpoons.....						561
Lobster pots.....			225	675	635	1,985
Dredges.....	20	935	8	312	45	2,092

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF FISHERIES OF RHODE ISLAND
IN 1919, BY COUNTIES—Continued.

Items.	Providence.		Washington.		Total.	
INVESTMENT—continued.						
Apparatus, shore fisheries:	Number.	Value.	Number.	Value.	Number.	Value.
Selnes.....	1	\$50	1	\$100	11	\$400
Gill nets.....					360	7,300
Pound nets and trap nets.....			27	29,600	138	101,750
Fyke nets.....			30	540	240	5,218
Dip nets.....					30	480
Lines, hand and trawl.....				265		4,492
Otter trawls.....			4	155	43	2,425
Harpoons.....						699
Lobster pots.....			5,527	16,293	21,936	65,346
Eel pots.....	280	255	175	165	995	1,035
Dredges.....			7	35	201	1,119
Tongs.....	42	405	8	65	241	1,983
Rakes.....	4	16	12	78	29	166
Hoes.....	55	53	24	22	152	145
Grabs.....					6	18
Shovels.....	22	22			43	43
Winkle pots.....					260	880
Shore and accessory property.....		370,570		27,755		978,622
Cash capital.....		81,500		9,500		209,300
Total.....		549,964		170,905		2,249,536
PRODUCTS.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Alewives.....			9,015	\$180	269,565	\$5,914
Bluefish.....			4,330	685	25,675	3,170
Bonito.....					114,810	10,925
Butterfish.....			26,525	1,506	758,845	39,188
Cod.....			25,000	1,160	1,148,331	49,747
Cunner.....					8,000	980
Eels.....	25,300	\$2,698	50,165	5,822	274,735	29,637
Flounders.....			722,040	24,572	2,451,579	79,567
Haddock.....					10,300	512
Herring.....			25,110	501	169,660	4,010
Mackerel.....			44,500	4,922	1,575,923	146,611
Menhaden.....					21,536,000	268,700
Perch, white.....					5,043	792
Pollock.....					99,400	5,930
Salmon.....			70	12	70	12
Scup.....			55,140	5,390	8,261,140	817,846
Sea bass.....			3,300	500	52,041	5,954
Squeteague.....			68,420	7,154	353,860	33,629
Striped bass.....			33,705	5,236	33,705	5,236
Swordfish.....					101,010	19,757
Tautog.....			65,775	5,340	371,660	22,191
Tuna.....			11,220	800	61,350	4,810
Whiting.....			178,500	1,870	1,583,700	16,010
Lobster.....			390,032	80,820	1,694,327	390,679
Crabs.....			8,330	502	34,330	1,802
Squid.....			197,314	10,665	377,579	18,730
Clams:						
Hard.....	27,128	10,918	39,056	14,650	1156,232	89,649
Soft.....	205,779	12,371	51,420	3,085	403,766	24,075
Scallops.....			504	251	33,994	14,688
Miscels.....					10,000	1,000
Winkles.....					10,500	2,100
Oysters, market, private.....	4,428,018	885,600	213,591	46,797	6,261,759	1,242,585
Irish moss.....					2,000	240
Total.....	4,686,306	911,987	2,224,082	222,450	48,250,883	3,296,578

¹ 19,529 bushels. ² 40,376 bushels. ³ 5,666 bushels. ⁴ 1,000 bushels. ⁵ 1,050 bushels. ⁶ 894,537 bushels.

FISHERIES BY APPARATUS.

The combined yield of all forms of apparatus employed in the vessel and shore fisheries of Rhode Island in 1919 amounted to 48,250,883 pounds, valued at \$3,296,578. Dredges employed principally in the oyster vessel fishery were the most productive form of apparatus, yielding 6,142,623 pounds of oysters and mussels, valued at \$1,217,637; while dredges, tongs, rakes, hoes, shovels, and grabs used in the shore fisheries took 723,122 pounds of oysters, clams,

and scallops, valued at \$124,280. Pound nets used in both the vessel and shore fisheries yielded 13,759,923 pounds, valued at \$1,051,315, of which 8,261,140 pounds, valued at \$799,846, were scup. Other important species taken in pound nets were: Butterfish, 625,095 pounds, valued at \$32,493; mackerel, 321,343 pounds, valued at \$30,139; squeteague, 311,260 pounds, valued at \$29,574; and flounders, 911,965 pounds, valued at \$27,574. The catch with pots amounted to 1,790,182 pounds, valued at \$370,399. Lobsters were the principal species taken in pots, amounting to 1,694,327 pounds, valued at \$360,679. Purse seines yielded 21,959,000 pounds, valued at \$308,150, of which 21,536,000 pounds were menhaden, valued at \$268,700, and 423,200 pounds were mackerel, valued at \$39,450.

Other important forms of apparatus employed in both the vessel and shore fisheries, arranged in the order of their importance, based on the value of their catch, were: Lines, with 1,389,986 pounds, mostly cod, bonito, and eels, valued at \$75,724; gill nets, with 759,980 pounds of mackerel, valued at \$70,632; other trawls, with 1,481,340 pounds, valued at \$50,389, consisting principally of flounders; and harpoons, with 101,010 pounds of swordfish, valued at \$19,757.

The catch of winkles with pots amounted to 10,500 pounds, valued at \$2,100. These are caught in winkle pots and are used for bait for cod. The pots are similar to the ordinary lobster pots, with the entrance at the top instead of at the end. The bait employed in the pots is of about the same character as that used in lobster pots.

The following tables give the products of the vessel and shore fisheries of Rhode Island in 1919, by counties, apparatus, and species:

YIELD OF VESSEL FISHERIES OF RHODE ISLAND IN 1919, BY COUNTIES, APPARATUS, AND SPECIES.

Apparatus and species.	Bristol.		Kent.		Newport.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Purse seines:						
Mackerel.....					423,200	\$39,450
Menhaden.....					21,536,000	268,700
Total.....					21,959,200	308,150
Gill nets: Mackerel.....					519,450	48,385
Pound nets:						
Alewives.....					60,110	1,202
Bluefish.....					11,200	1,140
Butterfish.....					133,750	6,695
Cod.....					40,100	2,010
Eels.....					3,520	452
Flounders.....					465,300	13,950
Mackerel.....					23,100	1,890
Scup.....					7,085,600	764,000
Sea bass.....					1,500	160
Squeteague.....					41,800	4,160
Tautog.....					13,550	675
Whiting.....					751,000	7,510
Squid.....					45,100	2,015
Total.....					9,275,530	805,859
Lines:						
Cod.....					840,711	37,280
Pollock.....					34,000	1,750
Tautog.....					8,000	600
Total.....					882,711	39,630
Otter trawls: Flounders.....	5,000	\$150			830,500	28,075
Harpoons: Swordfish.....					42,100	7,910

YIELD OF VESSEL FISHERIES OF RHODE ISLAND IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

Apparatus and species.	Bristol.		Kent.		Newport.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Lobster pots:						
Lobsters.....					17,500	\$3,890
Crabs.....					26,000	1,300
Total.....					43,500	\$5,190
Dredges:						
Mussels.....					10,000	1,000
Oysters, market, private.....	1,418,942	\$269,992	21,000	\$4,020	56,950	11,090
Total.....	1,418,942	269,992	21,000	4,020	66,950	12,090
Grand total.....	1,423,942	270,142	21,000	4,020	33,623,941	1,295,130

Apparatus and species.	Providence.		Washington.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Purse seines:						
Mackerel.....					423,200	\$39,490
Menhaden.....					21,536,000	268,700
Total.....					21,959,000	308,190
Gill nets: Mackerel.....					519,450	48,385
Pound nets:						
Alewives.....					60,410	1,300
Bluefish.....					11,200	1,100
Butterfish.....					133,750	6,680
Cod.....					40,100	2,000
Eels.....					3,520	400
Flounders.....					465,300	13,900
Mackerel.....					23,100	1,800
Scup.....					7,085,500	764,000
Sea bass.....					1,500	100
Squeteague.....					41,800	4,100
Tautog.....					13,550	600
Whiting.....					751,000	7,500
Squid.....					45,100	2,000
Total.....					9,275,530	805,800
Lines:						
Cod.....					846,711	37,280
Pollock.....					34,000	1,700
Tautog.....					8,000	800
Total.....					888,711	39,680
Otter trawls: Flounders.....			365,200	\$13,490	1,200,700	41,715
Harpoons: Swordfish.....					42,100	7,900
Lobster pots:						
Lobsters.....			16,500	3,500	34,000	7,300
Crabs.....					26,000	1,300
Total.....			16,500	3,500	60,000	8,600
Dredges:						
Mussels.....					10,000	1,000
Oysters, market, private.....	4,427,500	\$885,500	210,231	46,125	6,132,623	1,246,667
Total.....	4,427,500	885,500	210,231	46,125	6,142,623	1,247,667
Grand total.....	4,427,500	885,500	591,931	63,115	40,088,314	2,477,986

YIELD OF SHORE FISHERIES OF RHODE ISLAND IN 1919, BY APPARATUS, COUNTIES, AND SPECIES.

BY SEINES, POUND NETS, AND LINES.

Apparatus and species.	Bristol.		Newport.		Providence.		Washington.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Seines:										
Eels.....					10,920	\$1,211			10,920	\$1,211
Flounders.....	5,000	\$150							5,000	150
Herring.....			30,160	\$758					30,160	758
Mackerel.....							6,300	\$700	6,300	700
Perch, white.....			5,043	702					5,043	702
Tautog.....	10,000	500							10,000	500
Total.....	15,000	650	35,203	1,460	10,920	1,211	6,300	700	67,423	4,021
Pound nets:										
Alwives.....			200,440	4,534			9,015	180	209,455	4,714
Bluefish.....			19,145	1,345			4,350	685	14,475	2,030
Bonito.....			39,810	3,320					39,810	3,320
Butterfish.....	20,000	1,000	578,570	24,897			28,525	1,566	625,095	32,483
Cod.....			73,840	2,730			25,000	1,100	98,840	3,830
Eels.....	20,000	2,000	117,960	12,184			1,500	450	142,460	14,634
Flounders.....	30,000	900	175,985	5,292			240,680	7,432	446,665	13,624
Herring.....			114,300	2,751			25,110	501	139,400	3,252
Mackerel.....			284,943	26,117			36,400	4,022	321,343	30,139
Pollock.....			41,400	2,680					41,400	2,680
Salmon.....							70	12	70	12
Scup.....			520,500	48,466			55,140	5,390	575,640	53,846
Sea bass.....			46,231	5,255			3,300	500	49,531	5,755
Squeteague.....			243,640	22,515			67,620	7,059	311,260	29,574
Striped bass.....							31,555	4,836	31,555	4,836
Tautog.....	20,000	1,000	199,065	10,642			39,800	3,140	258,865	14,782
Tuna.....							10,230	720	10,230	720
Whiting.....			654,209	8,630			178,500	1,870	832,700	8,500
Squid.....			135,165	6,050			197,314	10,665	332,479	16,715
Total.....	90,000	4,900	3,439,314	190,368			955,079	50,158	4,484,393	245,456
Lines:										
Bonito.....			75,000	7,505					75,000	7,505
Cod.....			162,680	6,627					162,680	6,627
Eels.....	15,000	1,600	6,200	1,010			37,250	4,410	58,450	7,020
Flounders.....	1,330	40					21,550	740	22,880	780
Mackerel.....			40,200	3,600			1,800	200	42,000	3,800
Pollock.....			21,000	1,400					21,000	1,400
Sea bass.....			1,010	39					1,010	39
Squeteague.....							800	95	800	95
Striped bass.....							2,150	400	2,150	400
Tautog.....	790	61	29,000	1,485			25,975	2,200	55,845	3,746
Tuna.....			50,130	4,010			1,000	80	51,130	4,090
Crabs.....							8,330	592	8,330	592
Total.....	17,110	1,701	383,310	25,766			98,875	8,627	501,275	36,094

BY GILL NETS, FYKE NETS, DIP NETS, OTTER TRAWLS, AND HARPOONS.

Apparatus and species.	Kent.		Newport.		Washington.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Gill nets: Mackerel.....			240,530	\$22,247			240,530	\$22,247
Fyke nets:								
Flounders.....	510	\$15	35,184	1,021	5,000	\$150	40,694	1,186
Tautog.....	280		25,120	1,873			25,400	1,888
Total.....	790	30	60,304	2,894	5,000	150	66,094	3,074
Dip nets: Cunner.....			8,000	960			8,000	960
Otter trawls:								
Flounders.....			180,730	5,402	89,610	2,760	270,340	8,162
Haddock.....			10,300	512			10,300	512
Total.....			191,030	5,914	89,610	2,760	280,640	8,674
Harpoons: Swordfish.....			58,910	11,847			58,910	11,847
Grand total.....	790	30	558,774	43,862	94,610	2,910	654,174	46,802

YIELD OF SHORE FISHERIES OF RHODE ISLAND IN 1919, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY POTS.

Species.	Bristol.		Kent.		Newport.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Eels.....	32,450	\$3,442	.....	.....	4,020	\$429
Lobsters.....	24,300	4,780	9,413	\$1,993	1,253,062	269,256
Winkles.....	.....	.....	.....	.....	10,500	2,100
Total.....	56,750	8,222	9,413	1,993	1,267,582	271,785

Species.	Providence.		Washington.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Eels.....	14,470	\$1,487	8,415	\$962	59,355	\$6,320
Lobsters.....	.....	.....	373,552	77,320	1,660,349	353,349
Winkles.....	.....	.....	.....	.....	10,500	2,100
Total.....	14,470	1,487	381,967	78,282	1,730,182	361,769

BY DREDGES, TONGS, RAKES, HOES, SHOVELS, GRABS, AND HANDS.

Species.	Bristol.		Kent.		Newport.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Clams:	.....	.....	.....	.....	.....	.....
Hard.....	5,560	\$2,130	49,944	\$18,845	34,544	\$13,106
Soft.....	15,290	919	108,120	6,432	23,160	1,268
Scallops.....	400	200	31,074	13,125	2,016	1,002
Oysters, market, private.....	63,000	12,600	60,508	12,104	1,750	472
Irish moss.....	.....	.....	.....	.....	2,000	240
Total.....	84,250	15,849	249,646	50,506	63,470	16,118

Species.	Providence.		Washington.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Clams:	.....	.....	.....	.....	.....	.....
Hard.....	27,128	\$10,918	39,056	\$14,650	156,232	\$59,649
Soft.....	205,770	12,371	51,420	3,085	403,760	24,075
Scallops.....	.....	.....	504	251	33,994	14,608
Oysters, market, private.....	518	100	3,360	672	129,136	25,948
Irish moss.....	.....	.....	.....	.....	2,000	240
Total.....	233,416	23,389	94,340	18,658	725,122	124,530

WHOLESALE FISHERY TRADE.

The appended table shows the extent of the wholesale trade in Rhode Island in 1919. A considerable quantity of poultry grit, made by grinding oyster shells, was manufactured by one concern. To avoid the disclosure of individual enterprise the products of this plant are not included in the table.

WHOLESALE TRADE IN FRESH FISH, OYSTERS, CLAMS, SCALLOPS, AND LOBSTERS IN RHODE ISLAND IN 1919.¹

Item.	Number.	Value.	Item.	Number.	Value.
Establishments.....	40	\$928,355	Persons engaged.....	472	.....
Cash capital.....	.....	209,390	Wages paid.....	.....	\$422,330

¹ Includes one firm engaged in the manufacture of oyster-shell grit.

FISHERIES OF CONNECTICUT.

In 1919 Connecticut ranked third in the number of persons engaged and fourth in the investment and quantity and value of the products. The number of persons employed on fishing and transporting vessels was 647, in the shore or boat fisheries 1,019, and in the wholesale establishments, including the fertilizer plants, 623, representing a total of 2,289. The investment amounted to \$1,645,793, which includes 123 fishing and transporting vessels, valued at \$546,163, with a net tonnage of 3,869 tons and outfits valued at \$253,888; 763 power, sail, row, and other boats, valued at \$146,551; fishing apparatus employed in the vessel and shore fisheries to the value of \$101,992; shore and accessory property valued at \$498,699; and working cash capital to the amount of \$98,500.

The products of the fisheries amounted to 23,652,647 pounds, valued at \$1,700,638. The most important products were oysters, 12,197,703 pounds, or 1,742,529 bushels, valued at \$1,087,016; menhaden, 6,736,564 pounds, valued at \$93,312; flounders, 2,349,181 pounds, valued at \$91,962; lobsters, 740,848 pounds, valued at \$189,157; and shad, 463,203 pounds, valued at \$86,637.

Compared with 1905, there has been a decrease in the number of persons employed of 1,118, an increase in the investment amounting to \$10,040, and a decrease in the quantity of products taken amounting to 51,320,001 pounds and in the value amounting to \$1,473,310. The species for which the decrease in 1919 has been most marked as compared with 1905, with the amount of decrease, follow: Menhaden, 22,993,824 pounds; alewives, 1,054,878 pounds; swordfish, 362,287 pounds; squeteague, 138,503 pounds; bluefish, 124,292 pounds; and sea bass, 93,161 pounds. In the oyster fishery there has been a decrease, compared with the catch in 1905, amounting to 1,944,895 bushels, or 52.74 per cent, and with the catch in 1910, of 1,529,471 bushels, or 46.74 per cent.

FISHERIES BY COUNTIES.

Statistics of the number of persons employed, investment, and products of the fisheries in Connecticut are given by counties in the following table:

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF FISHERIES OF CONNECTICUT
IN 1919, BY COUNTIES.

Item.	Fairfield.		Hartford.		Middlesex.	
	Number.	Value.	Number.	Value.	Number.	Value.
PERSONS ENGAGED.						
On vessels fishing.....	337	.....	.....	.....	.....	.....
On vessels transporting.....	22	.....	.....	.....	.....	.....
In shore fisheries.....	88	.....	126	.....	275	.....
Shoresmen.....	254	.....	.....	.....	2	.....
Total.....	701	.....	126	.....	277	.....
INVESTMENT.						
Vessels fishing:						
Steam.....	16	\$195,193	.....	.....	.....	.....
Tonnage.....	1,116	.....	.....	.....	.....	.....
Outfit.....	.....	104,038	.....	.....	.....	.....

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF FISHERIES OF CONNECTICUT
IN 1919, BY COUNTIES—Continued.

Item.	Fairfield.		Hartford.		Middlesex.	
INVESTMENT—continued.						
Vessels fishing—Continued.	Number.	Value.	Number.	Value.	Number.	Value.
Gasoline.....	41	\$98,025				
Tonnage.....	568					
Outfit.....		53,740				
Sail.....	19	9,195				
Tonnage.....	135					
Outfit.....		5,035				
Vessels transporting:						
Steam.....	2	13,200				
Tonnage.....	111					
Outfit.....		9,627				
Boats:						
Sail, row, etc.....	35	2,040	73	\$1,582	73	\$1,514
Power.....	39	11,325	8	825	93	22,455
Apparatus, vessel fisheries:						
Otter trawls.....	7	300				
Harpoons.....		30				
Lobster pots.....	430	645				
Dredges.....	289	5,398				
Apparatus, shore fisheries:						
Seines.....	6	710	27	1,834	17	1,244
Gill nets.....	1	10	83	1,066	92	9,399
Pound nets.....					9	2,935
Fyke nets.....			296	2,043	37	447
Scoop nets.....			3	15		
Otter trawls.....	3	110			7	290
Lobster pots.....	2,085	4,060			1,353	3,953
Bel pots.....					145	123
Dredges.....	51	359				
Tongs.....	28	190			6	55
Rakes.....	17	116				
Hoes.....	8	10			15	18
Shore and accessory property.....		279,084		1,703		7,986
Cash capital.....		29,000				
Total.....		821,440		9,068		49,779
PRODUCTS.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Alewives.....			40,161	\$2,008	98,713	\$2,122
Bluefish.....			965	95		
Bullheads.....			60	6	365	17
Butterfish.....					50	3
Carp.....			11,854	1,637	18,509	2,145
Eels.....			4,768	1,038	6,420	608
Flounders.....	85,105	\$3,727			184,160	6,202
Menhaden.....	300	25			18,314	1,110
Perch, yellow.....			2,434	235	1,213	109
Pickarel.....			128	20	340	35
Shad.....			34,959	8,627	329,829	59,309
Smelt.....	4,114	886				
Squeteague.....					2,721	231
Striped bass.....					850	110
Sturgeon.....					25	5
Suckers.....			55,576	4,564	28,527	1,918
Sunfish.....			80	8	25	3
Swordfish.....	1,480	295				
Tautog.....					809	61
Lobsters.....	72,924	23,885			80,355	23,092
Clams:						
Hard.....	39,472	14,589				
Soft.....	8,000	725			12,200	804
Oysters:						
Market—						
Public.....	18,942	2,880			4,004	810
Private.....	2,570,197	227,935			5,614	1,001
Seed—						
Public.....	633,885	58,345				
Private.....	4,976,454	372,677				
Total.....	8,410,873	705,969	150,985	18,238	793,043	99,896

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF FISHERIES OF CONNECTICUT
IN 1919, BY COUNTIES—Continued.

Item.	New Haven.		New London.		Total.	
	Number.	Value.	Number.	Value.	Number.	Value.
PERSONS ENGAGED.						
On vessels fishing.....	112		87		566	
On vessels transporting.....	59				81	
In shore fisheries.....	272		258		1,019	
Shoresmen.....	301		66		623	
Total.....	774		411		2,289	
INVESTMENT.						
Vessels fishing:						
Steam.....	6	\$73,050	2	\$60,000	24	\$328,243
Tonnage.....	952		172		2,240	
Outfit.....		18,708		12,600		135,346
Gasoline.....	19	60,530	7	21,850	67	180,425
Tonnage.....	273		83		924	
Outfit.....		25,325		15,625		94,690
Sail.....	3	1,200	2	2,100	24	12,495
Tonnage.....	33		15		183	
Outfit.....		1,050		1,870		7,955
Vessels transporting:						
Steam.....					2	13,200
Tonnage.....					111	
Outfit.....						9,627
Gasoline.....	4	7,800			4	7,800
Tonnage.....	95				95	
Outfit.....		4,370				4,370
Barges.....	2	4,000			2	4,000
Tonnage.....	316				316	
Outfit.....		1,900				1,900
Boats:						
Sail, row, etc.....	156	2,773	62	1,461	399	9,670
Power.....	61	14,215	163	88,061	364	136,881
Apparatus, vessel fisheries:						
Purse seines.....			4	7,800	4	7,800
Gill nets.....			115	2,680	115	2,680
Lines.....				555		555
Otter trawls.....	1	30	6	350	14	680
Harpoons.....				570		600
Lobster pots.....	50	100			480	745
Dredges.....	83	3,039			372	8,437
Apparatus, shore fisheries:						
Seines.....			4	1,105	54	4,803
Gill nets.....			28	3,465	204	13,910
Pound nets.....	2	577	31	5,600	42	9,112
Fyke nets.....	4	75	132	1,420	439	3,985
Scoop nets.....			4	20	7	35
Lines.....		18		40		58
Otter trawls.....	10	361	33	1,643	53	2,391
Harpoons.....				80		80
Lobster pots.....	3,835	8,238	8,900	27,183	16,173	42,534
Eel pots.....	22	37	634	457	801	617
Dredges.....	4	36			55	395
Tongs.....	207	1,724	3	25	244	1,904
Rakes.....	44	251			61	367
Hoes.....	45	41			68	69
Shovels.....	13	13			13	13
Spears.....	28	34	2	5	30	39
Shore and accessory property.....		117,665		62,261		498,669
Cash capital.....		50,200		19,300		98,500
Total.....		427,380		338,126		1,645,793
PRODUCTS.						
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Alewives.....	500	\$5	37,776	\$2,502	177,150	\$6,637
Bluefish.....	660	80	2,085	211	3,710	386
Bonito.....			6,129	912	6,120	912
Bullheads.....			1,067	77	1,492	100
Butterfish.....			18,760	2,604	18,810	2,607
Carp.....			9,778	1,140	40,141	4,922
Cod.....			96,136	9,603	96,136	9,603
Cusk.....			6,767	73	6,767	73
Eels.....	11,153	1,960	37,705	6,233	63,016	9,839
Flounders.....	99,475	4,801	1,980,141	77,232	2,349,181	91,962
Haddock.....			350	38	350	38
Hake.....	100	2	10,100	100	10,200	102
Halibut.....			25,000	5,000	25,000	5,000
Herring.....			3,000	71	3,000	71
Mackerel.....	7,400	1,572	83,989	9,418	91,389	10,900

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF FISHERIES OF CONNECTICUT
IN 1919, BY COUNTIES—Continued.

Item.	New Haven.		New London.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
PRODUCTS—continued.						
Menhaden.....	102,350	\$350	6,615,600	\$91,827	6,736,564	\$93,312
Perch, yellow.....			2,461	251	6,108	595
Pickarel.....			611	88	1,079	143
Pollock.....			10,135	717	10,135	717
Sculp.....			1,980	202	1,980	202
Sea bass.....	210	60	3,345	468	3,555	528
Shad.....	327	83	98,088	18,618	463,203	86,637
Skates.....				10	400	10
Smelt.....			21,103	3,580	25,217	4,466
Squeteague.....	808	58	19,547	2,968	23,076	3,257
Striped bass.....	21	5	3,939	944	4,810	1,089
Sturgeon.....					25	5
Suckers.....			14,950	1,006	99,053	7,488
Sunfish.....					105	11
Swordfish.....			86,948	14,711	88,428	15,006
Tautog.....	500	50	20,633	1,957	21,942	2,068
Tomcod.....			455	37	455	37
Tuna.....			5,114	550	5,114	550
Whiting.....			9,317	175	9,317	175
Lobsters.....	163,674	45,633	423,895	96,547	740,848	189,157
Squid.....			3,612	258	3,612	258
Clams:						
Hard.....	10,504	4,323			149,976	18,912
Soft.....	208,950	30,541			229,150	32,070
Scallops.....			38,400	13,717	38,400	13,717
Oysters:						
Market—						
Public.....	106,708	15,210	7,000	3,000	4136,654	21,900
Private.....	2,250,857	242,830			4,826,668	471,706
Seed—						
Public.....	106,631	10,004			740,516	68,349
Private.....	1,517,411	152,324			6,493,865	525,001
Total.....	4,591,239	509,801	9,706,507	366,845	23,652,647	1,700,638

¹ 6,247 bushels.
² 22,915 bushels.

³ 6,400 bushels.
⁴ 19,523 bushels.

⁵ 689,524 bushels.
⁶ 105,788 bushels.

⁷ 927,605 bushels.

FISHERIES BY APPARATUS.

Dredges employed in the oyster fisheries of Connecticut in 1919 were the most productive form of apparatus. In the vessel fisheries dredges took 11,844,084 pounds, or 1,692,012 bushels, of oysters, valued at \$1,037,717, and in the shore fisheries dredges, tongs, rakes, and hoes took oysters to the amount of 353,619 pounds, or 50,517 bushels, valued at \$49,299, and clams to the amount of 279,126 pounds, or 29,162 bushels, valued at \$50,982. The catch with pots amounted to 768,078 pounds, valued at \$192,629, of which 740,848 pounds, valued at \$189,157, were lobsters. Otter trawls caught flounders, giant scallops, and hake to the amount of 2,359,221 pounds, valued at \$103,031. The catch with purse seines amounted to 6,625,240 pounds, valued at \$93,812, the principal species taken being menhaden to the amount of 6,608,400 pounds, valued at \$91,765. Gill nets, used principally in the taking of shad, yielded 443,551 pounds, valued at \$76,175. The quantity of shad taken with gill nets amounted to 374,823 pounds, or 86,567 in number, valued at \$69,201, of which 53,822 were roes and 32,745 were bucks. Various species were taken with lines, amounting to 201,763 pounds, valued at \$24,241; with pound nets, amounting to 379,371 pounds, valued at \$22,047; and with seines, amounting to 189,160 pounds, valued at \$21,680. All forms of apparatus employed in both the vessel and shore fisheries yielded a total of 23,652,647 pounds, valued at \$1,700,638.

The following tables give the products of the vessel and shore or boat fisheries in 1919, by counties, apparatus, and species:

YIELD OF VESSEL FISHERIES OF CONNECTICUT IN 1919, BY COUNTIES, APPARATUS, AND SPECIES.

Apparatus and species.	Fairfield.		New Haven.		New London.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Purse seines:								
Mackerel.....					16,840	\$2,047	16,840	\$2,047
Menhaden.....					6,608,400	91,765	6,608,400	91,765
Total.....					6,625,240	93,812	6,625,240	93,812
Gill nets: Mackerel.....					41,688	4,310	41,688	4,310
Lines:								
Cod.....					93,694	9,503	93,694	9,503
Halibut.....					25,000	5,000	25,000	5,000
Pollock.....					9,810	687	9,810	687
Total.....					128,504	15,190	128,504	15,190
Dredges: Oysters—								
Market—								
Public.....	1,400	\$160	3,500	\$610			4,900	776
Private.....	2,555,161	225,544	2,201,143	232,176			4,756,304	457,720
Seed—								
Public.....	627,583	48,369	72,632	6,817			600,215	55,186
Private.....	4,965,254	371,717	1,517,411	152,324			6,482,665	524,041
Total.....	8,049,398	645,790	3,794,686	391,927			11,844,084	1,037,717
Other trawls:								
Flounders.....	45,605	2,527	3,330	200	439,841	14,943	488,776	17,670
Hake.....					10,000	100	10,000	100
Scallops.....					2,816	853	2,816	853
Total.....	45,605	2,527	3,330	200	452,657	15,896	501,592	18,623
Lobster pots: Lobsters.....	14,131	5,141	2,476	793			16,607	5,934
Harpoons: Swordfish.....	1,480	295			76,828	12,501	78,308	12,796
Grand total.....	8,110,614	653,753	3,800,492	392,920	7,324,917	141,709	19,236,023	1,188,382

YIELD OF SHORE FISHERIES OF CONNECTICUT IN 1919, BY APPARATUS, COUNTIES, AND SPECIES.

BY SEINES AND GILL NETS.

Apparatus and species.	Fairfield.		Hartford.		Middlesex.		New London.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Seines:										
Alewives.....			39,484	\$1,988	16,484	\$277	800	\$40	56,768	\$2,305
Bullhead.....			60	6	300	14			360	20
Carp.....			9,373	1,381	12,512	1,460	6,810	\$06	28,695	3,647
Eels.....							4,440	\$01	4,440	\$01
Perch, yellow.....			530	44	299	27			829	71
Pickeree.....					109	12			109	12
Shad.....			18,873	4,595	26,407	4,626	5,088	1,219	50,368	10,480
Smelt.....	4,114	\$886					203	50	4,407	936
Striped bass.....							600	151	600	151
Suckers.....			27,511	2,235	15,045	1,016			42,556	3,251
Sunfish.....					25	3			25	3
Total.....	4,114	886	95,831	10,232	71,184	7,475	18,031	3,067	189,160	21,680
Gill nets:										
Alewives.....					11,446	385	9,297	1,572	20,743	1,957
Bluefish.....					925	92			925	92
Carp.....					31	3	2,968	334	2,999	337
Eels.....							94	9	94	9
Menhaden.....	300	25							300	25
Shad.....			15,465	3,876	298,428	48,392	92,930	16,933	374,823	69,201
Squeteague.....					1,104	111			1,104	111
Striped bass.....					850	110			850	110
Sturgeon.....					25	5			25	5
Total.....	300	25	15,465	3,876	282,809	49,098	103,289	18,848	401,863	71,847

YIELD OF SHORE FISHERIES OF CONNECTICUT IN 1919, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY POUND NETS, FYKE NETS, AND LINES.

Apparatus and species.	Hartford.		Middlesex.		New Haven.		New London.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Pound nets:										
Alewives.....			68,073	\$1,405	500	\$5	26,115	\$808	94,688	\$2,218
Bluefish.....			40	3			200	32	240	35
Butterfish.....			50	3			18,760	2,604	18,810	2,637
Carp.....			5,033	571					5,033	571
Cusk.....							6,767	73	6,767	73
Eels.....							2,150	300	2,150	300
Flounders.....			6,359	187			20,215	1,837	26,565	2,024
Herring.....							3,000	71	3,000	71
Mackerel.....							410	67	410	67
Menhaden.....			18,314	1,110	102,350	350	7,299	62	127,964	1,522
Perch, yellow.....			735	67			50	10	786	77
Scup.....							1,980	202	1,980	202
Sea bass.....					210	60			210	60
Shad.....			34,994	6,251	327	83	2,070	466	37,391	6,800
Skates.....							400	10	400	10
Squeteague.....			1,617	120			18,550	2,841	20,167	2,961
Striped bass.....							2,349	559	2,349	559
Suckers.....			6,069	384					6,069	384
Tautog.....			809	61	500	50	9,639	925	10,948	1,036
Tomcod.....							455	37	455	37
Whiting.....							9,817	175	9,817	175
Squid.....							3,612	258	3,612	258
Total.....			112,145	10,162	103,887	548	133,339	11,337	379,371	22,017
Fyke nets:										
Alewives.....	677	\$20	2,710	55			1,564	82	4,951	157
Bullhead.....			65	3			1,067	77	1,132	80
Carp.....	2,481	256	873	111					3,354	367
Eels.....	4,768	1,038	98	10			8,100	1,884	12,966	2,932
Flounders.....					495	28	5,740	325	6,235	353
Hake.....					100	2			100	2
Perch, yellow.....	1,904	191	178	15			2,411	241	4,493	447
Pickercil.....	128	20	231	23			611	88	970	131
Squeteague.....					808	58	111	14	919	72
Striped bass.....					21	5	210	39	231	44
Suckers.....	28,065	2,326	7,410	518			14,950	1,006	50,425	3,899
Sunfish.....	80	8							80	8
Tautog.....							300	33	390	36
Total.....	38,103	3,859	11,565	735	1,424	93	35,154	3,788	86,246	8,476
Lines:										
Bluefish.....					660	80	1,885	179	2,545	259
Bonito.....							6,120	912	6,120	912
Cod.....							2,442	100	2,442	100
Eels.....					515	48	2,012	357	2,527	405
Flounders.....					2,450	216	3,110	155	5,560	371
Haddock.....							350	38	350	38
Mackerel.....					7,400	1,572	25,051	2,994	32,451	4,566
Pollock.....							325	30	325	30
Sea bass.....							3,345	468	3,345	468
Smelt.....							310	45	310	45
Squeteague.....							786	113	786	113
Striped bass.....							780	195	780	195
Tautog.....							10,601	999	10,601	999
Tuna.....							5,114	559	5,114	559
Total.....					11,025	1,916	62,234	7,135	73,259	9,051

BY OTTER TRAWLS, HARPOONS, SCOOP NETS, POTS, AND SPEARS.

Apparatus and species.	Fairfield.		Hartford.		Middlesex.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Otter trawls: Flounders.....	31,500	\$1,200			177,810	\$6,015
Scoop nets: Shad.....			621	\$156		
Pots:						
Eels.....					6,323	598
Lobsters.....	58,793	18,744			80,355	23,092
Total.....	58,793	18,744			86,677	23,690
Grand total.....	98,293	19,944	621	156	264,487	29,705

YIELD OF SHORE FISHERIES OF CONNECTICUT IN 1919, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY OTTER TRAWLS, HARPOONS, SCOOP NETS, POTS, AND SPEARS—Continued.

Apparatus and species.	New Haven.		New London.		Total.	
	<i>Pounds.</i>	<i>Value.</i>	<i>Pounds.</i>	<i>Value.</i>	<i>Pounds.</i>	<i>Value.</i>
Otter trawls:						
Flounders.....	93, 200	\$4, 357	1, 511, 535	\$59, 972	1, 822, 045	\$71, 544
Scallops.....			35, 584	12, 864	35, 584	12, 864
Total.....	93, 200	4, 357	1, 547, 119	72, 836	1, 857, 629	84, 408
Harpoons: Swordfish..			10, 120	2, 210	10, 120	2, 210
Scoop nets:						
Shad.....					621	156
Smelt.....			20, 500	3, 485	20, 500	3, 485
Total.....			20, 500	3, 485	21, 121	3, 641
Pots:						
Eels.....	276	42	20, 632	2, 832	27, 230	3, 472
Lobsters.....	161, 198	44, 840	423, 895	96, 547	724, 241	183, 223
Total.....	161, 474	44, 882	444, 527	99, 379	751, 471	186, 695
Spears: Eels.....	13, 362	1, 870	277	50	13, 639	1, 920
Grand total.....	268, 036	51, 109	2, 022, 543	177, 960	2, 653, 980	278, 874

BY DREDGES, TONGS, RAKES, HOES, AND SHOVELS.

Species.	Fairfield.		Middlesex.		New Haven.		New London.		Total.	
	<i>Pounds.</i>	<i>Value.</i>	<i>Pounds.</i>	<i>Value.</i>	<i>Pounds.</i>	<i>Value.</i>	<i>Pounds.</i>	<i>Value.</i>	<i>Pounds.</i>	<i>Value.</i>
Clams:										
Hard.....	39, 472	\$14, 589			10, 504	\$4, 323			49, 976	\$18, 912
Soft.....	8, 000	725	12, 200	\$804	208, 950	30, 541			229, 150	32, 070
Oysters:										
Market—										
Public.....	17, 542	2, 720	4, 004	810	103, 208	14, 600	7, 000	\$3, 000	131, 754	21, 130
Private.....	15, 036	2, 391	5, 614	1, 001	49, 714	10, 654			70, 364	14, 046
Seed—										
Public.....	106, 302	9, 976			33, 999	3, 187			140, 301	13, 163
Private.....	11, 200	960							11, 200	960
Total.....	197, 552	31, 361	21, 818	2, 615	406, 375	63, 305	7, 000	3, 000	632, 745	100, 281

WHOLESALE FISHERY TRADE AND MENHADEN INDUSTRY.

In 1919 there were 25 establishments engaged in the wholesale fishery trade of Connecticut, employing 559 persons, to whom \$338,884 were paid in wages. The value of these establishments with their equipment, etc., was \$418,801 and the cash capital utilized amounted to \$81,500.

There were only two factories engaged in the reduction of menhaden to oil and scrap. The statistics of these plants have been included in the fishery industries table of Massachusetts.



DEPARTMENT OF COMMERCE

BUREAU OF FISHERIES

HUGH M. SMITH, Commissioner

**ALASKA
FISHERY AND FUR-SEAL INDUSTRIES
IN 1920**

By WARD T. BOWER

Agent, Alaska Service

**APPENDIX VI TO THE REPORT OF THE U. S. COMMISSIONER
OF FISHERIES FOR 1921**



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ALASKA FISHERY AND FUR-SEAL INDUSTRIES IN 1920.¹

By WARD T. BOWER, Agent, Alaska Service.

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¹ Appendix VI to the Report of the U. S. Commissioner of Fisheries for 1921. B. F. Doc. 902.

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INTRODUCTION.

The Bureau's work in Alaska was conducted along the usual lines in the calendar year 1920. Shortage of funds handicapped the work of the fisheries service early in the season before the new appropriations became available July 1. A force of temporary stream watchmen was again made use of during the active fishing season, working under the direction of the Bureau's permanent employees in the patrol of the fishing grounds for the enforcement of the laws and regulations. Vessels of the subchaser type and one mine sweeper were stationed in southeastern Alaska to aid in law enforcement.

A further study was made of the condition of the salmon fishery of the Yukon River, and an expedition was sent into the Bristol Bay region which did excellent work in the destruction of predatory fishes and gathered certain information in regard to the spawning beds and runs of red salmon in streams tributary to Bristol Bay. Five hearings were held by the Bureau at Cordova and Seattle late in the year, and further restrictions imposed on commercial fishing for salmon in Alaska.

Private salmon hatcheries were inspected as usual, and work was continued by the Bureau at its hatcheries on McDonald Lake and at Afognak. Excellent progress was made in the marking of the mouths of salmon streams, one vessel in the southeastern district being almost exclusively engaged in the work. Detailed statistics of the fishery industry of Alaska were collected and compiled as heretofore.

In accordance with the recommendation repeatedly made by the Secretary of Commerce and the Commissioner of Fisheries, the Department of Commerce has been relieved of jurisdiction over certain minor fur-bearing animals in Alaska. The act of May 31, 1920, contained a section placing the land fur-bearing animals of Alaska under the control of the Bureau of Biological Survey, of the Department of Agriculture, and transferred to the Department of Commerce jurisdiction over walruses and sea lions. The Department of Commerce retains jurisdiction over the fur seals and sea otters, and over the blue fox herds of the Pribilof Islands. The Bureau's files and all matters pertaining to the land fur-bearing animals, including the leasing of islands for fur-farming, were promptly delivered to the Bureau of Biological Survey, which assumed jurisdiction upon the approval of the act. This report, therefore, does not contain a section dealing with the protection of the so-called minor fur-bearing animals of Alaska. Employees of this Bureau in Alaska have co-operated with representatives of the Bureau of Biological Survey whenever possible in the establishment of their work.

The Bureau's activities in connection with the taking of fur-seal skins and administration of the natives' affairs on the Pribilof Islands were carried on in the usual manner. The total take of sealskins in the calendar year 1920 was 26,648, having an estimated value of about \$1,000,000. The take of blue fox skins on the Pribilofs in the winter of 1920-21 was the largest for nearly 30 years, totaling 1,125 blues and 14 whites, with an estimated value of about \$100,000.

Transportation of necessary food, fuel, and supplies for the natives and white employees on the Pribilof Islands, together with return of products, was afforded through the courtesy of the Navy Department and the Coast Guard.

Two sales at public auction of sealskins taken on the Pribilof Islands were held at St. Louis in 1920 by the selling agents of the Bureau. The sale of fox skins was postponed because of low prices, but was held early in 1921.

The author of this report is greatly indebted to Assistant Agent E. M. Ball for compilation of statistics of the fisheries and preparation of accompanying text. Acknowledgment is also made to C. E. Crompton for assistance in the preparation of statistics and text in regard to the fur-seal industry.

REGULAR EMPLOYEES, ALASKA SERVICE.

During the year 1920 the following regular employees have been identified with the Alaska service of the Bureau:

REGULAR EMPLOYEES IDENTIFIED WITH THE ALASKA SERVICE IN 1920.

Name.	Position.	Headquarters or chief place of duty.
Ward T. Bower.....	Chief agent.....	Washington, D. C.
Edward M. Ball.....	Assistant agent.....	Juneau.
Harry J. Christoffers.....	do.....	Seattle.
Calvin F. Townsend.....	Inspector.....	Fairbanks.
Shirley A. Baker.....	Assistant agent.....	Cordova.
Lemuel G. Wingard.....	do.....	Naknek. (Promoted Oct. 1, 1920, from warden.)
A. H. Proctor.....	Superintendent.....	St. Paul Island. (Promoted July 1, 1920, from agent and caretaker, St. Paul Island.)
Charles E. Crompton.....	Agent and caretaker.....	St. George Island.
Henry D. Aller.....	do.....	St. Paul Island. (Promoted July 1, 1920, from storekeeper, St. Paul Island.)
G. Dallas Hanna.....	Storekeeper.....	St. Paul Island. (Resigned Jan. 15, 1920.)
Edward C. Johnston.....	do.....	St. George Island. (Promoted Apr. 16, 1920, from school-teacher.)
Henry C. Scudder.....	do.....	St. Paul Island. (Resigned as warden Apr. 23, 1920. Reinstated, assistant agent, July 1, 1920. Promoted Oct. 1, 1920.)
John J. Richstein.....	Physician.....	St. Paul Island. (Resigned June 30, 1920.)
Henry H. Stromberger.....	do.....	St. Paul Island. (Reinstated July 1, 1920. Resigned Aug. 4, 1920.)
W. C. Huyler.....	do.....	St. Paul Island. (Appointed Oct. 5, 1920. Resigned Nov. 18, 1920.)
George B. Bowlby.....	do.....	St. Paul Island. (Appointed Nov. 19, 1920.)
William M. Murphy.....	do.....	St. George Island.
Herschel Silverstone.....	Assistant to agent.....	St. Paul Island. (Resigned Sept. 30, 1920.)
Henry Mygatt.....	do.....	St. Paul Island. (Appointed Oct. 1, 1920.)
George Haley.....	School-teacher.....	St. Paul Island. (Resigned July 19, 1920.)
Lois L. Proctor.....	do.....	St. Paul Island.
Richard Culbertson.....	do.....	St. Paul Island. (Appointed July 20, 1920.)
Carl E. Fletcher.....	do.....	St. George Island. (Appointed May 29, 1920. Resigned Oct. 9, 1920.)
John M. Orchard.....	do.....	St. George Island. (Appointed Oct. 12, 1920.)
Michael J. O'Connor.....	Warden.....	Juneau.
Fred H. Gray.....	do.....	Wrangell.
Philip R. Hough.....	do.....	Juneau. (Resigned June 30, 1920.)
Joseph N. Braun.....	do.....	Ikatan. (Appointed May 1, 1920.)
William E. Baumann.....	do.....	Afognak. (Appointed July 20, 1920.)
Chauncey C. Combs.....	do.....	Haines. (Appointed July 26, 1920. Resigned Sept. 30, 1920.)
James K. Nevill.....	do.....	Wrangell. (Appointed Aug. 1, 1920.)
Arthur L. Mellick.....	Master power vessel Elder.....	Unalaska.
Edwin Hofstad.....	Master steamer Osprey.....	Wrangell.
Jesse L. Nevill.....	Master patrol vessel Auklet.....	Do.
George G. Naud.....	Master patrol vessel Murrie.....	Juneau.
Albert K. Brown.....	Clerk.....	Washington, D. C.
Mary S. Haines.....	do.....	Do.
William P. Rasin.....	do.....	Do.
Marguerite McBride.....	do.....	Washington, D. C. (Transferred to Coast and Geodetic Survey, Feb. 3, 1920.)
E. Elaine Bell.....	do.....	Seattle.
Gladys M. Gamlen.....	do.....	Seattle. (Resigned Mar. 6, 1920. Reinstated June 8, 1920.)

REGULAR EMPLOYEES AT GOVERNMENT HATCHERIES IN ALASKA IN 1920.

Location and name.	Position.
Afognak:	
Edwin Wentworth.....	Superintendent.
Harry J. Heuver.....	Foreman.
Russel Noyes.....	Fish-culturist. (Resigned June 30, 1920.)
Fred R. Lucas.....	Fish-culturist.
Thomas H. Morton.....	Fish-culturist. (Promoted Mar. 16, 1920 from apprentice fish-culturist at Afognak to fish-culturist at McDonald Lake. Transferred Sept. 16, 1920, to Afognak.)
Alfred Nelson.....	Apprentice fish-culturist.
Nicolai Boskofsky.....	Apprentice fish-culturist. (Appointed Oct. 6, 1920.)
Mildred I. Morton.....	Apprentice fish-culturist. (Appointed Nov. 4, 1920. Resigned Dec. 31, 1920.)
F. J. Stewart.....	Cook. (Resigned Dec. 31, 1920.)
McDonald Lake:	
C. H. Van Atta.....	Superintendent.
Calvin D. Ryan.....	Foreman.
William L. Stiles, Jr.....	Fish-culturist. (Transferred Mar. 1, 1920, to Leadville, Colo.)
Thomas H. Morton.....	Fish-culturist. (Promoted Mar. 16, 1920, from apprentice fish-culturist, Afognak. Transferred Sept. 16, 1920, to fish-culturist, Afognak.)
Albert L. Carlton.....	Fish-culturist.
Everett V. Campbell....	Apprentice fish-culturist. (Resigned Apr. 30, 1920.)
Lawrence T. Hopkinson.	Apprentice fish-culturist. (Appointed June 5, 1920. Transferred Sept. 1, 1920, to statistical agent, Washington, D. C.)
Clarence Houts.....	Apprentice fish-culturist. (Resigned Aug. 14, 1920.)
Anton Hougén.....	Apprentice fish-culturist. (Appointed Nov. 1, 1920.)
Barney Sevisen.....	Do.
Casper Udstrand.....	Apprentice fish-culturist. (Appointed Nov. 6, 1920.)
Stella A. Campbell.....	Cook. (Resigned Apr. 30, 1920.)
John P. Mobley.....	Cook. (Appointed May 1, 1920.)

FISHERY INDUSTRIES.

As in corresponding reports for previous years, the Territory of Alaska is here considered in the three coastal geographic sections generally recognized, as follows: Southeast Alaska, embracing all that narrow strip of mainland and the numerous adjacent islands from Portland Canal northwestward to and including Yakutat Bay; central Alaska, the region on the Pacific from Yakutat Bay westward, including Prince William Sound, Cook Inlet, and the southern coast of Alaska Peninsula, to Unimak Pass; and western Alaska, the north shore of the Alaska Peninsula, including the Aleutian Islands and Bristol Bay and the Kuskokwim and Yukon Rivers.

Detailed reports and statistical tables dealing with the various fishery industries are presented herewith, and there are also given the important features of certain subjects which were the objects of special investigation or inquiry.

WATERS CLOSED TO COMMERCIAL FISHING.

Section 6 of the act approved June 26, 1906, for the protection and regulation of the fisheries of Alaska, is as follows:

Sec. 6. That the Secretary of Commerce may, in his discretion, set aside any streams or lakes as preserves for spawning grounds, in which fishing may be limited or entirely prohibited; and when, in his judgment, the results of fishing operations in any stream, or off the mouth thereof, indicate that the number of salmon taken is larger than the natural production of salmon in such stream, he is authorized to establish close seasons or to limit or prohibit fishing entirely for one year or more within such stream or within five hundred yards of the mouth thereof, so as to permit salmon to increase: *Provided, however,* That such power shall be exercised only after all persons interested shall be given a hearing, of which due notice must be given by publication; and where the interested parties are known to the Department they shall be personally notified by a notice mailed not less than thirty days previous to such hearing. No order made under this section shall be effective before the next calendar year after same is made: *And provided further,* That such limitations and prohibitions shall not apply to those engaged in catching salmon who keep such streams fully stocked with salmon by artificial propagation.

Pursuant to the provisions of this section, action was taken in 1920 in regard to waters of southeastern Alaska; waters between Cape Spencer and Cape Newenham, including Bering and Copper Rivers, Kuskokwim River, and Yukon River.

Under date of May 22, 1920, announcement was made of a hearing to be held to consider the necessity or desirability of making changes in the regulations in regard to the Yukon River. The text of the announcement was as follows:

It having been recommended that the Secretary of Commerce amend the order of December 14, 1918, limiting or prohibiting fishing for salmon in the Yukon River, Alaska, its tributary waters, and the waters of its delta, notice is hereby given under the provisions of section 6 of the act of Congress approved June 26, 1906, entitled "An act for the protection and regulation of the fisheries of Alaska," that a hearing, for the purpose of eliciting information as to what,

if any, changes in the present Yukon River regulations are necessary or desirable, will be held at the office of the Bureau of Fisheries, 1217 L. C. Smith Building, Seattle, Wash., on November 23, 1920, at 10 o'clock a. m., at which time and place all interested persons will be heard. All persons having pertinent information are particularly invited to be present and to impart such information.

Under date of May 25, 1920, announcement was made of a hearing to be held in respect to fishing in the Kuskokwim River. The text of the announcement was as follows:

It having been recommended that the Secretary of Commerce limit or prohibit fishing for salmon or other fishing in the prosecution of which salmon are taken or injured, in the Kuskokwim River, Alaska, its tributary waters, and within the area 500 yards outside the mouth of that river, notice is hereby given under the provisions of section 6 of the act of Congress approved June 26, 1906, entitled "An act for the protection and regulation of the fisheries of Alaska," that a hearing to determine the advisability of limiting or prohibiting fishery operations in the waters in question will be held at the office of the Bureau of Fisheries, 1217 L. C. Smith Building, Seattle, Wash., on November 30, 1920, at 10 o'clock a. m., at which time and place all interested persons will be heard. All persons having pertinent information are particularly invited to be present and to impart such information.

Under date of August 18, 1920, announcement was made of hearings to consider the necessity or desirability of changing the regulations regarding fishing in Copper River waters. The text of the announcement was as follows:

It having been recommended that the Secretary of Commerce amend the order of December 20, 1918, limiting or prohibiting fishing in the Copper River, Alaska, and its delta and all tributary waters, notice is hereby given under the provisions of section 6 of the act of Congress approved June 26, 1906, entitled "An act for the protection and regulation of the fisheries of Alaska," that hearings for the purpose of eliciting information as to what, if any, changes in the present Copper River regulations are necessary or desirable will be held at Cordova, Alaska, on October 5, 1920, at 10 o'clock a. m., and at the office of the Bureau of Fisheries, 1217 L. C. Smith Building, Seattle, Wash., on November 18, 1920, at 10 o'clock a. m., respectively, at which all interested persons will be heard. All persons having pertinent information are particularly invited to be present and to impart such information.

Under date of October 30, 1920, announcement was made of a hearing to be held in respect to amending the order of November 30, 1917, in regard to fishing in Bering River. The text of the announcement was as follows:

It having been recommended that the Secretary of Commerce amend the order of November 30, 1917, the provisions of which are continued in the order of December 23, 1919, prohibiting commercial fishing operations in Bering River and its tributary waters, including Bering Lake, above a line extending at right angles across Bering River from a point approximately 800 feet northwesterly from the mouth of Gandil River, Alaska, notice is hereby given under the provisions of section 6 of the act of Congress approved June 26, 1906, entitled "An act for the protection and regulation of the fisheries of Alaska," that a hearing to determine the advisability of further limiting or prohibiting fishing operations in Bering River and its tributary waters, including Bering Lake, will be held at the office of the Bureau of Fisheries, 1217 L. C. Smith Building, Seattle, Wash., on December 3, 1920, at 10 o'clock a. m., at which time and place all persons interested will be heard.

Following the hearings on October 5, November 18, 23, and 30, and December 3, the Department, under date of December 18, 1920, promulgated the following order:

Hearings having been given, after due notice in accordance with law, for the purpose of determining the advisability of limiting or prohibiting fishing in

certain waters in Alaska, and to amend or modify certain existing regulations, and all persons having had full opportunity to be heard, it is hereby ordered, by virtue of the authority vested in me by section 6 of "An act for the protection and regulation of the fisheries of Alaska," approved June 26, 1906, that until further notice all fishing for salmon, or other fishing in the prosecution of which salmon are taken or injured, in all hereinafter-described waters of Alaska be and is hereby made subject to the following limitations and prohibitions in addition to the general restrictions already applicable by virtue of existing laws and regulations.

1. Waters east of the longitude of Cape Spencer:

(a) All fishing is prohibited in all salmon streams and their tributaries and lakes.

(b) All fishing, except with purse seines and drift gill nets, is prohibited within 500 yards of the mouths of all salmon streams.

(c) All fishing with purse seines and drift gill nets is prohibited within 200 yards of the mouths of all salmon streams, and all fishing with purse seines and drift gill nets as well as with all other apparatus is prohibited within 500 yards of the mouths of Chilkat River, Chilkoot River, Anan Creek, Hetta Creek, Sockeye Creek, and Naha Stream.

2. All fishing is prohibited in all salmon streams, their tributaries and lakes, and within 500 yards of the mouths of such streams, flowing into the Pacific Ocean or Bering Sea between Cape Spencer and Cape Newenham, except as follows:

(a) Fishing is permitted in Copper River and its tributaries in accordance with the terms of the order promulgated December 20, 1918, which order is continued in full force until September 1, 1921, upon which date said order of December 20, 1918, becomes of no further force or effect, and on and after September 1, 1921, and until further notice, all fishing for salmon, or other fishing in the prosecution of which salmon are taken or injured, in the Copper River, its tributaries and lakes, and within 500 yards of each mouth of the Copper River, is prohibited.

(b) Fishing is permitted at Karluk beyond the zone 100 yards outside the mouth of Karluk River where it breaks through Karluk Spit into Shelikof Strait.

(c) Fishing is permitted in Ugashik River below a line extending at right angles across the Ugashik 500 yards below the mouth of King Salmon River.

3. On and after September 1, 1921, all fishing is prohibited in the Kuskokwim River, its tributaries and lakes, and within 500 yards of the mouth of the Kuskokwim for other than local use in Alaska.

4. Fishing is permitted in the Yukon River and its tributaries in accordance with the terms of the order promulgated December 14, 1918, which order is continued in full force until September 1, 1921, on which date said order of December 14, 1918, becomes of no further force or effect, and on and after September 1, 1921, and until further notice, all fishing for salmon, or other fishing in the prosecution of which salmon are taken or injured, in the Yukon River, its tributaries and lakes, and within 500 yards of each mouth of the Yukon, is prohibited for other than local use in Alaska.

5. The driving of salmon downstream and the causing of salmon to go outside the protected area at the mouth of any salmon stream are expressly prohibited.

6. This order does not apply to persons taking salmon with rod, hand line, or spear for their personal or family use and not for sale or barter.

7. The waters of the Afognak Reservation are covered by presidential proclamation of December 24, 1892, and the regulations promulgated by authority thereof are not modified or affected by this order but remain in full force.

8. All previous orders of the Secretary of Commerce imposing limitations or prohibitions upon fishing in the waters covered by this order, except as hereinbefore indicated, are hereby superseded.

9. This order becomes effective January 1, 1921.

Limitations and prohibitions upon fishing are applicable in the waters of the Yukon and Copper Rivers by virtue of previous orders of the Secretary of Commerce. Limitations have been placed upon fishing by Executive order or proclamation in the following additional waters: Afognak Reservation, Aleutian Islands Reservation, Yes Bay and Stream, and the Annette Island Fishery Reserve.

STREAM MARKING.

In order to make more effective the closing order of December 23, 1919, and to serve as a helpful guide to the fishermen, it was considered advisable to indicate by appropriate notices at suitable places on shore the protected waters off the mouth of each salmon stream in which fishing is prohibited. Though these notices in themselves could not prevent unlawful encroachments on the streams, they would serve as guides to those instinctively law-abiding and as warning to those having no respect for the fishery laws and regulations. Thus no one could plead in extenuation of a violation of the regulations that there were no visible means defining the bounds wherein operations would be illegal.

The placing of markers at the mouths of streams is therefore intended to be helpful to the fishermen in enabling them to locate the outer boundary of the protected area of each stream, and at the same time the markers serve the further purpose of making more certain to those engaged in the enforcement of the law and regulations that encroachments upon prohibited waters are not accidental.

The procedure generally followed in southeast Alaska in locating markers has been to define arbitrarily the mouths of streams at the line of mean low tide, unless physical conditions rendered such action impracticable. This is the case at some streams where considerable areas of silt have been deposited, which at low tide are exposed as comparatively extensive mud flats. Owing to the varied conditions encountered, no inflexible rule could be laid down for the determination of stream mouths, but as far as practicable the mouth of each stream was to be fixed at the line of mean low tide. Where this could not be done, authority was given to mark the mouths of such streams at the line of mean high tide.

Gratifying progress was made in the work of marking stream mouths in southeast Alaska. Signboards were erected at 189 streams. Of that number the mainland is credited with 21 streams, Chichagof Island with 60, Yakobi Island 2, Baranof Island 18, Admiralty Island 28, Kupreanof Island 5, Zarembo Island 1, Wrangell Island 2, Etolin Island 5, Mitkof Island 1, Kosciusko Island 6, and Prince of Wales Island 40. There are several hundred more salmon streams in southeast Alaska which have not been marked, but which will be given attention as funds may be available for such work.

In central Alaska markers were placed in 1920 at Eyak River, Mountain Slough, and Glacier River, all of which are streams of the delta of the Copper River, the several other outlets of the Copper having been marked in 1919. The Karluk River was also marked in 1920.

The salmon streams in western Alaska are comparatively large and few in number. Of those tributary to Bristol Bay seven were marked in 1920. They are as follows: Nushagak, Snake, Igushik, Kvichak, Naknek, Egagik, and Ugashik Rivers. The mouth of the Yukon River was marked in 1919.

STREAM WATCHMEN.

No more important work than the watching of salmon streams engages the attention of the Alaska service. The preservation of the

salmon runs may depend largely upon the degree of protection afforded in this manner, for experience has shown beyond doubt that most satisfactory results are thus obtained. The duty of stream watchmen is to prevent unlawful fishing in the streams where they are stationed and within the proscribed area off the mouths thereof.

In 1920 six men were employed as stream watchmen, of whom Fred W. Dost, Eric N. Aldrich, Earl C. Nelson, and John F. Ross were assigned to the southeastern district. The other two, Kenneth C. Cole and John J. Folstad, were stationed at Abercrombie and Karluk, respectively. By consent of the governor of Alaska, Joseph A. Bourke, a Territorial officer, was detailed to fishery work in the Prince William Sound region during the fishing season.

Three other men, Chauncey C. Combs, James K. Nevill, and William E. Baumann, began work in July as stream watchmen, but they were soon appointed permanent wardens in the Alaska fisheries service, and are therefore not to be counted in this category. The regular force of the service, including these three wardens, numbered 11 men, which, with the 6 stream watchmen and the 1 special assistant previously referred to, constituted a service of 18 men actively engaged in the protection of the fisheries of Alaska. In addition there were, of course, the men engaged in operating the several vessels used in protective work.

FISHERY PATROL.

BUREAU PATROL BOATS.

Five boats, owned by the Bureau, were used in patrolling the fishing grounds of Alaska in 1920. Three of them, the steamer *Osprey* and the power boats *Auklet* and *Murre*, operated in southeastern Alaska, while the other two, the *Swan* and *Tern*, were used on the Yukon River and tributaries, cruising together during much of the season. In addition the launch *Dixie* and the power boats *Anthouette* and *Try It* were chartered in July, August, and September for patrol service in the Juneau district. The launch *Prospector* was chartered in June and July for similar service on Prince William Sound and the Copper River flats.

The *Osprey* was transferred from the central district to southeastern Alaska in July, where it was used almost entirely in the work of marking the mouths of salmon streams. While being beached near Cordova, preparatory to having her hull cleaned and copper painted, the *Osprey* settled in the gravel and turned over on May 25, falling away from the shore at low water. The boat did not right itself on the flood tide, but filled with water and remained in this partly submerged condition for about a week until assistance was rendered by the Coast Guard cutter *Algonquin*, then in the vicinity. The following extract from a report by the Commodore Commandant of the Coast Guard describes the circumstances attending the salvage of the *Osprey*:

On May 30, while on her way to Latouche, the *Algonquin* received a dispatch from the headquarters of the Coast Guard at Washington, stating that the Bureau of Fisheries had requested her assistance in salvaging the steamer *Osprey*, ashore at Cordova. The cutter immediately headed for the stranded vessel and found her in Orca Inlet, 5 miles north of Cordova. She was lying

on her side, full of water. It was decided that a barge or scow was necessary to float the vessel, so the *Algonquin* proceeded to Cordova in search of one. A suitable scow, belonging to the Bering River Coal Co., was obtained, brought to the steamer *Osprey*, and hauled alongside her. On June 3 the *Osprey* was righted, floated, and made fast to a dolphin. The water was then bailed out of her.

In April the *Murre* was seriously damaged by striking a rock in Keku Strait while engaged on census work for the Bureau of Education. She was towed to Wrangell by the *Auklet* and repaired at a cost of \$1,623.87.

The following statement shows the mileage made by the patrol boats owned by the Bureau in their cruises of 1920: *Auklet*, 7,616; *Murre*, 6,635; *Osprey*, 3,793; *Swan*, 3,067; *Tern*, 2,367; total mileage, 23,478. In addition to the foregoing, extensive mileage was made by chartered patrol boats, especially the *Dixie*.

NAVAL AND OTHER PUBLIC VESSELS.

In March, 1920, a rather elaborate program was arranged between the Governor of Alaska and the Navy Department, Treasury Department, and the Department of Commerce, whereby certain vessels under the direction of each department were to participate in fishery patrol work in Alaska. The original order as approved by the heads of the three departments designated the following vessels to constitute a fleet for the protection of the fisheries of the Territory:

Naval vessels: *Eagle 57*, submarine chaser No. 294, and submarine chaser No. 309. (Subchaser No. 310 was detailed instead of No. 309.)

Coast Guard vessels: *Bothwell*, *Algonquin*, *Bear*, *Earp*, and *Unalga*.

Coast and Geodetic Survey vessels: *Explorer*, *Lydonia*, *Surveyor*, and *Wenonah*.

Eagle 57 and two subchasers, No. 294 and No. 310, were in Alaska during the summer months. The chasers reached Alaska in May and remained until the end of the fishing season. Subchaser No. 294, while commanded by Lieut. Thompson, United States Navy, made an energetic patrol of the district south of Petersburg, and did much to suppress trap robberies and illegal fishing generally. Subchaser No. 310 was similarly engaged in the district north of Petersburg, though much less actively. *Eagle 57* struck a reef at Gambier Bay July 3, en route from Bremerton to Juneau, and lost her propeller. On July 4 the vessel was towed to Juneau by the *Explorer* and several weeks later was towed to the Puget Sound Navy Yard by a naval tug. Thus *Eagle 57* performed no service in the interest of the fisheries of Alaska and was replaced on August 1 by the mine sweeper *Swallow*.

The commanding officer aboard each of these naval vessels was authorized by the Secretary of Commerce, under date of April 23, 1920, to make searches, arrests, and seizures in accordance with the provisions of the Alaska alien fisheries act of June 14, 1906. They, or other officers of the Navy assigned to this patrol, were also commissioned as deputy United States marshals, and at least one officer was appointed a United States commissioner.

The vessels of the Coast Guard were primarily in Alaskan waters to carry on the Bering Sea patrol for the protection of the fur-seal

herds annually resorting to the Pribilof Islands. A statement regarding this patrol appears in the fur-seal section of this report.

The vessels of the Coast and Geodetic Survey were engaged in the vitally important work of that service in different coastal districts of Alaska and therefore could not be expected to have opportunities to do much for the fisheries.

WAR DEPARTMENT REGULATIONS.

Early in 1920 a rather general protest was registered before the Chief of Engineers of the War Department by various interests in Alaska against the location of floating fish traps in offshore positions, it being contended that such traps were a menace to navigation. After considerable inquiry into the matter, the Acting Chief of Engineers issued, on April 22, 1920, a temporary order for the regulation of floating traps, as follows:

During the calendar year 1920 no floating pound net or fish trap in the navigable waters of Alaska shall exceed 2,400 feet in length over all nor be constructed and operated in more than 100 feet depth of water at the outer end of the net or trap at mean high tide according to the United States tide tables; with the exception that a floating pound net or fish trap may be constructed and operated in a greater depth of water, provided the extension, measured from the shore line, at mean high-tide line, does not exceed 1,000 feet over all.

At the same time announcement was made that public hearings would be held during the year to determine the advisability of continuing or modifying the order. Accordingly two hearings were held in 1920—one at Juneau on September 14 and the other at Seattle on November 19—as a result of which the War Department continued without modification the order of April 22. On January 5, 1921, new regulations were issued prescribing the conditions under which fishery operators may construct and maintain fish traps in the navigable waters of Alaska. The regulations are as follows:

WAR DEPARTMENT, OFFICE OF THE CHIEF OF ENGINEERS, *Washington, January 5, 1921.*

NOTE.—It is to be understood that this authority does not give any property rights either in real estate or material, or any exclusive privileges; and that it does not authorize any injury to private property or invasion of private rights, or any infringement of Federal, Territorial, or local laws or regulations, nor does it obviate the necessity of obtaining Territorial assent to the work authorized. It merely expresses the assent of the Federal Government so far as concerns the public rights of navigation. (See *Cummings v. Chicago*, 188 U. S., 410.)

To whom it may concern:

The attention of those fishing in the waters of the coast of the Territory of Alaska, and in the navigable waters tributary thereto, is called to the provisions of section 10 of the river and harbor act of March 3, 1899, as follows:

"SEC. 10. That the creation of any obstruction not affirmatively authorized by Congress to the navigable capacity of any of the waters of the United States is hereby prohibited; and it shall not be lawful to build or commence the building of any * * * weir * * * or other structure in any * * * navigable river or other waters of the United States, outside established harbor lines, or where no harbor lines have been established, except on plans recommended by the Chief of Engineers and authorized by the Secretary of War."

In accordance with the above provision of law, and until further notice, all fishermen who desire to operate in the waters above described, and under conditions stated as follows, but not otherwise, and whose written applications may receive the approval of the district engineer of the engineer department at large, in charge of the locality, are hereby authorized by the Secretary of War to construct and maintain fish weirs, traps, or pounds erected in the usual manner as heretofore, subject to the following conditions:

CONDITIONS.

1. All persons desiring to erect and maintain fish weirs, traps, or pounds under this authority shall make application to the District Engineer, United States Engineer Office, Seattle, Wash., giving their names, their addresses, the proposed location of their weir, trap, or pound, and evidence that the proper license has been granted by the Territory of Alaska.

2. That no floating fish trap shall exceed 2,400 feet in length over all, nor be constructed and operated in more than 100 feet depth of water at the outer end of the trap at mean high tide, according to the United States tide tables, with the exception that a floating trap may be constructed and operated in a greater depth of water, provided the extension measured from the shore line at mean high tide does not exceed 1,000 feet over all.

3. That all the apparatus used and the work herein authorized shall be subject to the supervision and approval of the aforesaid district engineer, who may temporarily suspend the work at any time if, in his judgment, the interests of navigation so require.

4. That no weir, trap, or pound shall be located or built in such place or manner as to unreasonably obstruct or interfere with navigation.

5. That on the outer end of the weir, trap, or pound the permittee or owner shall maintain a sign inscribed with the license number in numerals not less than 6 inches in height, capable of being readily read from passing vessels, and failure to keep such sign conspicuously displayed shall be sufficient reason for the cancellation of this authority and for prosecution as provided in the next paragraph. All renewals of the Territorial license shall be reported to the aforesaid district engineer when they occur, together with the Territorial license number. All changes of ownership shall also be reported to him immediately, and the permit shall be returned to him for proper notation thereon of such changes.

6. That upon the abandonment of the location or upon ceasing to use any weir, trap, or pound, as hereby authorized, the permit and the map or maps attached thereto shall be immediately returned to the aforesaid district engineer, with notice of the abandonment, and the owner shall immediately remove the structure at his own expense, including all piling, stakes, etc., to the satisfaction of the aforesaid district engineer. Failure to so remove the same shall be considered good ground for prosecution of the permittee or owner for maintaining an illegal structure endangering navigation, as set forth in sections 10 and 12 of the river and harbor act of March 3, 1899: *Provided*, That if the use of said structure is suspended temporarily it may be maintained in whole or in part if the license number is conspicuously displayed and the trap is properly lighted or otherwise marked, as may be necessary to prevent unreasonable obstruction to navigation. Any fish weir, trap, or pound allowed to go into a condition of disrepair so that it can not be readily seen, or on which the license number is not conspicuously displayed, will be regarded as abandoned, and if not promptly removed or marked as above provided will subject the permittee or owner to prosecution, and any trap not in use on which the license number is not displayed will be subject to removal by the United States at any time.

7. That if future operations by the United States require an alteration in the position of the weir, trap, or pound, or if the latter, in the opinion of the Secretary of War, shall cause unreasonable obstructions to the free navigation of the said waters, the permittee will be required, upon due notice from the Secretary of War, and within 30 days thereafter, to remove or alter the weir, trap, or pound, or obstruction caused thereby, without expense to the United States, so as to render navigation reasonably free, easy, and unobstructed. No claim shall be made against the United States on account of such removals or alterations.

8. That fishing structures and appliances in navigable waters of the United States shall be lighted for the safety of navigation, as follows:

"The lights shall be displayed between sunset and sunrise. They shall be placed at each end of the structure, excepting where the inner end terminates in such situation that there is no practicable navigation between it and the high-water line of the adjacent coast, in which case no inner light shall be displayed. The outer light shall be white and the inner light shall be red. The size, capacity, and manner of maintenance of the lights shall be such as may be specified in the War Department permit authorizing the erection of the structure or appliance.

"When several structures or appliances are placed on one line with no navigable passage between them they will be considered, for lighting purposes, as one structure."¹

9. That there shall be installed and maintained on the weir, trap, or pound, by and at the expense of the permittee, such additional lights and signals as may be prescribed by Bureau of Lighthouses, Department of Commerce, and that provision shall be made by watchman or otherwise for proper attendance of lights and signals, so that they will at all times be in effective condition.

10. That this authority is revocable at will by the Secretary of War, and unless otherwise specified in the permit, or unless previously revoked under paragraph 7 above, shall cease and be null and void. (Date to be specified by the district engineer, not more than five years after date of issuance of permit.)

Recommended:

LANSING H. BEACH,
Major General, Chief of Engineers.

Approved:

W. R. WILLIAMS,
Assistant Secretary of War.

ALASKA FISHERY INTELLIGENCE SERVICE.

Through the cooperation of the Alaska Military Telegraph & Cable System, information was sent to and posted at frequent intervals in the telegraph offices at Wrangell, Petersburg, Craig, Sitka, Juneau, Cordova, and Seward, reporting the price of fresh halibut, sablefish, and red rockfish at Ketchikan. At less frequent intervals the price of pickled salmon and herring was also reported. In like manner the Seattle price for the same fresh and pickled fish was reported to those towns and to Ketchikan. This service is understood to have been of real value to the fishermen in enabling them to take advantage of the best market for their products, and it was continued for their benefit.

INSPECTION OF CANNERIES.

Canneries in Alaska are subject at all times to inspection by employees of the Alaska service of the bureau, but this inspection is limited chiefly to an examination of the fish with reference to the time they have been dead. The inspection also includes the wanton waste of food fish in Alaska, whether at the fishery establishments or on the fishing grounds.

There is also a cannery inspection service authorized by the National Canners' Association but supported largely if not entirely by the packing companies operating canneries in Alaska or by as many of them as contribute to the maintenance of the service. The plants of companies which do not contribute are not inspected by employees of that service. This work is somewhat in its infancy, having been started rather experimentally two years ago chiefly, it is understood, to reduce the fire risk at the canneries, to further provide for satisfactory sanitation at the plants, and to promote the general welfare and comfort of employees. The work of this service is no doubt well worth while, although it has no mandatory authority to prevent the

¹ Regulations of Department of Commerce, approved June 19, 1913.

canning of fish which in the judgment of its employees should not be canned. The superintendent of the plant is ordinarily the responsible head of affairs, with absolute control of operations, and is thus not definitely bound by the actions, recommendations, or suggestions of the inspectors.

In 1920 this private inspection service was competently conducted under the supervision of Dr. E. D. Clark, of Seattle, who for many years was identified with the U. S. Bureau of Chemistry. Its personnel was made up chiefly of students from the Fisheries College at the University of Washington. The Government has no direct connection with the inspection service thus maintained under the auspices of the National Cannery Association but approves of its general purposes and objects.

VIOLATIONS OF FISHERIES LAWS AND REGULATIONS.

Fishery work before the courts of Alaska in 1920 involved prosecutions for failure to close the tunnels and open the heart walls of traps during the weekly close season, fishing in streams and lakes closed to commercial operations, fishing within 500 yards of the mouths of salmon streams, disregard of the lateral distance interval between fixed appliances, and the wanton waste of salmon. It also covered the completion of prosecutions begun in 1919. In most cases the penalties imposed were fines, though in one case the sentence was imprisonment for one month. Fines aggregated \$6,480.95, of which amount \$101 was imposed in central Alaska, \$158.80 in western Alaska, and \$6,263.15 in the southeastern district. Costs of prosecutions, which ordinarily follow the judgments, are included in these amounts, as far as they were reported, but the record is incomplete as in several instances the costs had not been computed at the time reports were made. The total amount of penalties would therefore be increased somewhat by including these costs.

On September 13, 1919, William Strong was indicted at Juneau as an alien, having engaged in fishing in Taku River August 3, 1919. The case came to trial on March 4, 1920, at which time Strong pleaded guilty and was fined \$100.

The Alaska Pacific Fisheries was indicted in 1919 for not opening the heart walls of two traps on Sunday, August 3, 1919, and tried at Ketchikan. The jury failed to agree on a verdict. On April 28, 1920, the case was again tried in the district court at Ketchikan and resulted in an acquittal of the company.

On July 17 the Alaska Pacific Fisheries was accused in a complaint filed before the United States commissioner at Juneau of failing to close the tunnel of its trap at Neck Point, Chichagof Island, during the weekly close period on July 11. The case was tried on August 6, but the jury did not agree on a verdict. Subsequently the case was dismissed on motion of the United States attorney.

The case against the Ward's Cove Packing Co., indicted in the fall of 1919 for fishing with two traps on Sunday, August 3, 1919, was called for trial at Ketchikan, April 26, 1920. The company pleaded guilty and was fined \$200 and costs.

On November 23, 1920, the Ward's Cove Packing Co. was indicted at Ketchikan for illegally fishing with a trap in Clarence Strait 4

miles north of Dall Head on August 2. The case was continued to the March, 1921, term of court.

At the April term of court in Ketchikan, Gus Starkloff, who was indicted the previous fall for unlawful fishing in Staney Creek, Prince of Wales Island, September 22, 1919, was arraigned, pleaded guilty, and paid a fine of \$50.

At the same term of court Jack Peratovich and five other natives were arraigned under an indictment accusing them of fishing with a seine in Staney Creek in 1919 contrary to law. They pleaded guilty and were each fined \$50.

In October, 1919, T. Kato, a Japanese, was indicted as an alien for fishing with a gill net in the waters of southeastern Alaska on June 5, 1919. The case was called for trial at Ketchikan on April 30 and resulted in an instructed verdict for the defendant, it having been testified that he was not fishing, but was merely demonstrating the use of a gill net.

Jenkins & Jenkins were indicted in 1919 at Ketchikan for having driven a trap within a lateral distance of 600 yards of a floating trap then in operation. The case was tried in Ketchikan in April, 1920, resulting in an acquittal of the defendants on the ground that the floating trap was movable, and that therefore only the lateral distance interval of 100 yards was applicable in this instance.

At the September, 1919, term of the district court held at Juneau, Tony Flagas was indicted for fishing in Berners Bay during the close season on September 15, 1919. Counsel for the defendant demurred to the indictment for the reason that it did not state that Flagas was fishing for salmon. The demurrer was sustained, and the violation is therefore in the status of having been unreported.

On Sunday, May 23, Paul Rappas was found fishing with a gill net in Shoemaker Bay. On May 24 a complaint was filed against Rappas before the United States commissioner at Wrangell, whereupon he pleaded guilty and was fined \$120 and costs of \$8.

On September 15, 1919, Pete Knutsen and Ole Knutsen were indicted on two counts for (a) fishing in Petersburg Creek with a gill net covering more than one-third the width of the stream and (b) fishing with a gill net extending across more than one-third the width of the water of the estuary at Petersburg Creek. They were tried at Ketchikan on November 8, 1919, and convicted on the second count. On November 15 motion for a new trial was made. It was denied on November 13, 1920, and a fine of \$250 and costs was imposed. Notice of an appeal was then given but was not completed, and the fine and costs of \$56.65 were paid later.

The case against the Hidden Inlet Canning Co., indicted in the fall of 1919 for constructing in Peril Strait, near False Island, a fish trap within 500 yards of the mouth of a salmon stream, was tried at Juneau October 11, 1920, and resulted in an acquittal of the company, there being no satisfactory evidence presented to the jury that the stream was used by salmon.

In September two indictments were returned against the Hidden Inlet Canning Co. The first covered two counts and accused the company of not closing the tunnels of two traps on Sunday, July 18. Both traps were located on Chichagof Island, one being one-fourth of a mile south of White Rock and the other 2 miles north of Basket Bay. A plea of guilty on each count was entered when the case was called for trial in October, and a fine of \$50 for each offense

was imposed. The second indictment alleged that the company had not closed on Sunday, July 25, the tunnel of a trap located on Chichagof Island $3\frac{1}{2}$ miles south of South Passage Point. Upon being arraigned the company pleaded guilty and was fined \$100. This violation was originally reported in a complaint filed before the United States commissioner at Juneau on August 31, but it was subsequently reported to the grand jury upon dismissal of the complaint.

On September 13 complaint was made before the United States commissioner at Juneau against Libby, McNeill & Libby charging it with failure to close the tunnel of its Douglas Island trap, near Shoal Point, during the weekly close season on September 5. Arraignment was made immediately upon issuance of the complaint. The company pleaded guilty and was fined \$100 and costs of \$2.85. Complaint was also made against Paul Benson and John Smith, watchmen at the trap. Both men pleaded guilty and paid a fine of \$25 each and costs of \$2.85.

In November, F. Lloyd was indicted at Ketchikan for illegally operating a floating trap near Harry Bay, during the weekly close period on July 31, by not opening the heart walls and not closing the tunnel. On December 9 the case was called and a plea of guilty was entered. The defendant was fined \$50 and paid costs of \$90.65.

On August 2, a trap on the west shore of Gravina Island, 3 miles north of Dall Head, belonging to Rounsefell & Co., was found in full fishing order. Report was made to the grand jury at Ketchikan, and, on November 23, a true bill was returned. The case was called for trial in December and the company pleaded guilty. A fine of \$100 and costs of \$21.05 were imposed.

On Sunday, August 1, a trap of the Jensen Fish Co. located in Nichols Passage near Blanks Inlet was found with heart walls closed and tunnel only partly closed. These facts were presented to the grand jury in Ketchikan on November 23 and an indictment resulted. The company pleaded guilty on December 8, and was fined \$100 and costs of \$45.

On July 7 complaint was filed before the United States commissioner at Juneau, charging that the Marathon Fishing & Packing Co. had not closed on Sunday, July 4, the tunnel of a trap operated by it on Admiralty Island, $1\frac{1}{2}$ miles south of Gambier Bay. The case was called for trial on August 19, when the defendant pleaded guilty and paid a fine of \$200.

On July 7 the Petersburg Packing Corporation was accused in a complaint filed at Juneau before the United States commissioner of not closing, on July 4, the tunnel of its pile trap located on the south shore of Admiralty Island, one-half mile northeasterly from Deep-water point. Similar complaints were made against A. J. Young and Jesse Fowler, watchmen at the trap. The cases were called for trial on August 2. The company pleaded guilty and was fined \$200 and costs of \$5. The complaints against the watchmen were dismissed for the reason that they claimed it was impossible for them to close the tunnel.

On July 7 complaint was filed before the United States commissioner at Juneau, charging the Petersburg Packing Corporation with failure to close on Sunday, July 4, the tunnel of a floating trap

located 1 mile southeast of Point Brightman, Admiralty Island. The case was dismissed on motion of the United States attorney.

On July 7 complaint was filed before the United States commissioner at Juneau alleging that the Washington Bay Packing Co. had not closed the tunnel of a trap on the southeast shore of Admiralty Island, one-half mile southeast of Point Brightman, supposedly owned and operated by that company, on Sunday, July 4, though at that time the trap bore no name, number, or other means of identification. The complaint was subsequently withdrawn, as the company disclaimed ownership of the trap. However, on July 23, when the trap was again inspected, it carried the name of the Washington Bay Packing Co. In view of that fact, the matter was presented, on September 17, to the grand jury at Juneau, and an indictment resulted. The case was tried October 28, and the company was acquitted.

On September 17 the Washington Bay Packing Co. was also indicted for not having closed on Sunday, July 4, the tunnel of its trap located on the south shore of Admiralty Island, $2\frac{1}{2}$ miles north-east of Wooodsky Harbor. When the case was called for trial in October, the company pleaded guilty and was fined \$100 and costs.

On July 7 the Southern Alaska Canning Co. was accused in a complaint filed before the United States commissioner at Juneau of not closing on Sunday, July 4, the tunnels of two of its floating traps, one of which was located at Point Napean and the other at Point Wilson, on the south and west shores, respectively, of Admiralty Island. Trial was had July 20, when a plea of guilty was entered. A fine of \$400 and costs of \$8.60 were paid. A similar complaint was made against Lenard Ekholm, watchman at the Point Wilson trap, but it was dismissed on condition that he should not again violate the law by leaving the tunnel open during the remainder of the close seasons of the year.

On August 31 the Southern Alaska Canning Co. was further accused in a complaint filed before the United States commissioner at Juneau of having failed to provide during the weekly close season beginning July 24 an opening for the free passage of salmon and other fish through the heart of its trap located 1 mile north of Point Gardiner, Admiralty Island. The peculiarity of this case was that the company technically complied with the law by opening the heart walls, but it had, in fact, obstructed the passage of fish through the opening thus made by extending a jigger from the heart to the pot, thus, in effect, circumventing the law. Prosecution was vigorously contested, but a conviction resulted, whereupon the company was fined \$350.

On July 7 the Sanborn-Cutting Co. was accused in a complaint filed before the United States commissioner at Juneau of having violated the law in two instances, Sunday, July 4, in not closing the tunnels of two of its floating traps, located, respectively, in Herring Bay, Admiralty Island, and Frederick Sound north of Carroll Island. The case was called for trial July 17, at which time the company pleaded guilty and paid a fine of \$250 and costs of \$8.70. D. Simmons, watchman at the Herring Bay trap, against whom a complaint was also made, pleaded guilty and was fined \$100 and costs of \$35.30. There was no watchman at the other trap.

On July 7 the Fidalgo Island Packing Co. was accused in a complaint filed at Juneau before the United States commissioner of not closing on Sunday, July 4, the tunnel of a trap on the southern shore of Admiralty Island. Upon being arraigned July 26 the company pleaded guilty and paid a fine of \$150 and costs of \$8.

On August 31 the Fidalgo Island Packing Co. was further accused in a complaint filed before the United States commissioner at Juneau of not closing the tunnels of two traps on the southern shore of Admiralty Island during the weekly close season July 24. The traps were located one-third and $1\frac{1}{4}$ miles, respectively, northeast of Murder Cove. The company pleaded guilty to both offenses on September 9 and paid a fine of \$200 and costs of \$3.85.

On July 17 a complaint was filed before the United States commissioner at Juneau accusing the Booth Fisheries Co. of not closing the tunnel of two of its traps on Sunday, July 11. Both traps were located on the northern shore of Chichagof Island, one near Point Augusta and the other seven-eighths of a mile southeasterly from Pulizzi Island. The case was tried August 6 and resulted in an acquittal of the company. A complaint was also filed against Carl Edensword and Karl Christensen, watchmen at the Point Augusta trap, similarly charging them, but they were likewise acquitted. There was no watchman at the other trap.

On July 17 the Deep Sea Salmon Co. was accused in a complaint filed before the United States commissioner at Juneau of not closing the tunnels of two of its traps on Sunday, July 11. Both traps were located on the northern shore of Chichagof Island, one near White-stone Harbor and the other near Spasskaia Bay. When the case came up for trial July 19 the company pleaded guilty and was fined \$100 and costs of \$4.20. Complaint was also made against Theodore Thorsen, watchman at one trap. Upon being arraigned, he pleaded guilty and was fined \$100 and costs of \$5. No watchman was found at the other trap.

On August 31 the Wilson Fisheries Co. was accused in a complaint filed before the United States commissioner at Juneau of two violations of the law in that two of its traps were not closed on Sunday, July 25. The traps were located at or near Wilson Cove, Admiralty Island. The case was called on September 14 but was dismissed on motion of the United States attorney, as the Government had but one witness.

A complaint filed before the United States commissioner at Juneau on August 31 accused the Standard Salmon Packers (Inc.) of failing to close on Sunday, July 25, the tunnel of its trap in Tenakee Inlet, 4 miles west of South Passage Point. Upon being brought to trial September 3 the company pleaded guilty and paid a fine of \$50 and costs of \$3.85.

On August 27 the Auk Bay Salmon Canning Co. and Charles Smith, owner and watchman, respectively, were accused in a complaint filed before the United States commissioner at Juneau of not closing the tunnel of the company's trap at Outer Point, Douglas Island, during the weekly close season on August 7. The case was called for trial on August 28, when both defendants pleaded guilty. The company was fined \$100 and costs of \$2.85, and the watchman \$25 and costs of \$2.85.

On July 17 P. E. Harris & Co. was accused in a complaint filed before the United States commissioner at Juneau of five violations of the law on Sunday, July 11, in that the tunnels of five of its traps on the western shore of Mansfield Peninsula were not closed. The trial was held on August 6 and resulted in a conviction on one count and disagreement on the other four. The company was fined \$500, upon payment of which the four other counts were dismissed.

On August 31 P. E. Harris & Co. was accused in a complaint filed before the United States commissioner at Juneau of not closing on Sundays, August 1 and 8, the tunnel of one of its floating traps on the western shore of Mansfield Peninsula. The case was tried on September 3 and resulted in a conviction and fine of \$350 and costs. An appeal was taken. A complaint was also made against D. A. Demick, trap watchman, but it was dismissed. Subsequently the same information was laid before the grand jury and an indictment returned. These cases were consolidated and tried before the district court on November 5 and 6, and a conviction again secured. Motion for a new trial being denied, the court imposed a fine of \$350 and costs against the company and a fine of \$50 and costs against Demick.

P. E. Harris & Co. and Jack Carlson, owner and watchman, respectively, of a trap located $3\frac{1}{2}$ miles north of Hawk Inlet on the western shore of Mansfield Peninsula, were indicted separately by the grand jury at Juneau in September for not closing the tunnel of the trap on Sunday, August 1. The original action in respect to this violation was the filing of a complaint against the company and watchman before the commissioner at Juneau, but on motion of the United States attorney the complaints were dismissed and the matter presented to the grand jury, thus avoiding retrial in event of a conviction in the lower court and appeal to the district court. The company was tried on November 3 and 4 and acquitted. The bench warrant for Jack Carlson was returned unserved, he having left Alaska before the date of his indictment.

In September P. E. Harris & Co. was indicted for not closing on Sunday, August 8, the tunnel of its pile trap located $2\frac{1}{4}$ miles south of Hawk Inlet, Admiralty Island. This case was first taken before the United States commissioner at Juneau on a complaint filed August 31, but that action was dismissed on September 11.

At the same term of court another indictment was returned against P. E. Harris & Co., alleging that this same trap did not have its tunnel closed on Monday, August 9, during the close season on that day. The indictment contained a further count which alleged that the tunnel of a floating trap owned by this company and located one-half mile north of Hawk Inlet was not closed during the same close season. As in similar cases, complaints were first filed before the commissioner at Juneau alleging the commission of offenses as above indicated, but they were dismissed in order that the facts could be presented to the grand jury with the result as noted.

On August 31 two complaints were filed before the commissioner at Juneau accusing P. E. Harris & Co. of not closing on Sundays, August 15 and 22, the tunnel of a pile trap located $2\frac{1}{4}$ miles south of Hawk Inlet. These complaints were dismissed, and the information they contained was laid before the grand jury with the result that a

true bill was returned. These three cases were tried on November 1, 3, and 4, and an acquittal secured in each one.

On August 16 Ben Fox and Bert Dennis, natives, were charged in a complaint filed before the United States commissioner at Haines with having on that day fished with a gill net in Chilkoot River. They pleaded guilty and were each fined \$5.

On August 31 C. H. Gallagher was accused in a complaint filed before the United States commissioner at Juneau with not closing on Sundays, August 15 and 22, the tunnel of his trap located on the northern end of Chichagof Island between Hoonah Island and Flynn Cove. The case was called for trial September 7. Gallagher pleaded guilty and was fined \$25 and costs amounting to \$41.85.

On August 23 the Beegle Packing Co. was accused in a complaint filed before the United States commissioner at Ketchikan of fishing with a floating trap on the southern shore of Revillagigedo Island west of Coho Cove during the weekly close season of August 22. The company pleaded guilty when the case was called for trial and paid a fine of \$100.

On August 27 the Alaska Sanitary Packing Co. was charged in a complaint filed before the United States commissioner at Wrangell with having failed to open during the close season on August 7 the heart walls of two traps located on Prince of Wales Island 4 miles north of Point Baker. The company claimed extenuating circumstances in defense, but pleaded guilty and paid a fine of \$25 for each trap and total costs of \$9.20.

Charles Norberg was accused in a complaint filed before the United States commissioner at Petersburg on August 30 of fishing with a purse seine within the prohibited distance of the mouth of Blind River, Mitkof Island, on August 3. He pleaded guilty and was fined \$30 and costs.

By a complaint filed before the United States commissioner at Petersburg on August 30 Jack Hollingstad was also accused of fishing with a purse seine within the closed area at the mouth of Blind River on August 7. Upon arraignment he pleaded guilty and paid a fine of \$40 and costs.

In September Chester Worthington, a native of Wrangell, was accused by the grand jury at Juneau of illegal fishing August 24 in a salmon stream of Port Houghton. The case was tried at Juneau, October 15, and resulted in a conviction. On October 19 Worthington was sentenced to serve one month in the Federal jail at Juneau.

The Pacific American Fisheries was indicted in September for not closing on August 14 the tunnel of one of its pile traps located on the southern shore of Pleasant Island. The case was called at Juneau on October 22, and the trial ended in a conviction of the company. Motion for a new trial being made and denied, the company, on November 13, was fined \$300 and costs of \$42. Notice of an appeal was entered, but upon the expiration of the period in which a bill of exception might be filed the company paid the fine, thus closing the case.

On August 7 Jack David and Patty Gonate, natives, were caught fishing with gill nets in Chilkoot Lake. They were so accused in a complaint filed that day before the United States commissioner at Haines. Both men pleaded guilty, and each paid a fine of \$20 and costs of \$16.

On November 23 complaint was filed in the United States commissioner's court at Ketchikan accusing the Fresh Fish Co. of fishing during the weekly close season on August 1 with a trap located on the eastern shore of Prince of Wales Island, $3\frac{1}{2}$ miles north of Cape Chacon. The company pleaded guilty and paid a fine of \$50 and costs of \$5.50.

The Starr-Collinson Packing Co. was indicted at the November term of court in Ketchikan for not opening the heart walls of its trap No. 748, Prince of Wales Island, during the weekly close season on August 1. The case has not been tried.

On July 21 a complaint was filed before the United States commissioner at Latouche accusing the Copper River Packing Co. and Kentuck Graves and Edward Hammer, two of its fishermen, of setting a gill net in Eshamy Lagoon on July 15 a distance of 192 feet from a net of the Kenai Packing Co. Upon trial, pleas of guilty were entered and a fine of \$25 and cost was imposed.

A second complaint was filed on July 21 in the same court, charging the Copper River Packing Co., Kentuck Graves, and Edward Hammer with setting another gill net a distance of 182 feet from the net of the Kenai Packing Co. Graves assumed responsibility and pleaded guilty when the case was called for trial. He was fined \$25 and costs.

On July 1 a complaint was filed before the United States commissioner at Valdez, charging the Copper River Packing Co. with having set a trap within 500 yards of the mouth of a salmon stream on Chenega Island. The trial of the case began August 10 and continued until noon August 12. The defendant company was acquitted, the court holding that the mouth of the stream was above the lagoon, a distance of more than 500 yards, and, further, that the stream was not one in which salmon could spawn or would be chosen by salmon for spawning.

On July 21 a complaint was filed before the United States commissioner at Latouche, accusing the Copper River Packing Co., Kentuck Graves, and Edward Hammer of setting a net on July 15 within 500 yards of the mouth of a red salmon stream emptying into Eshamy Lagoon. When the case came up for trial, July 24, the defendants produced as witness a surveyor who disputed the measurements made by a witness for the Government. The case was finally dropped on condition that the company vacate the site, which it did.

On July 21 complaint was filed before the United States commissioner at Latouche charging that A. Gustofson and J. S. Groll had fished with two traps at the entrance of Eshamy Lagoon on Sunday, July 18. Gustofson assumed responsibility, pleaded guilty, and was fined \$1 and costs for each offense.

On July 21 the King Salmon Fisheries Co. was accused in a complaint filed before the commissioner at Latouche of having set on July 14 two nets within 500 yards of the mouth of Miners River, a red salmon stream tributary to Unakwik Inlet, Prince William Sound. J. S. Groll, superintendent for the company, H. L. Neilson and W. St. Clair, fishermen, appeared as defendants in the case. Pleas of guilty were entered, and a fine of \$25 and costs was imposed in each case.

During the weekly close season on Saturday, July 10, a trap at Knowles Head belonging to the Moore Packing Co. was found to

be fishing. Complaint was entered before the United States commissioner at Cordova, and the case tried on August 6. The company was acquitted.

The Carlisle Packing Co. was accused in a complaint filed before the commissioner at Cordova of fishing with a trap at Porcupine Point during the weekly close season on Saturday, July 10. The case was tried August 6 at Cordova, but the jury failed to agree on a verdict. On motion of the assistant United States attorney the case was dismissed.

At the October term of the district court at Valdez the grand jury indicted the Kenai Packing Co. and the Copper River Packing Co. for the wanton waste of salmon. The Copper River Packing Co. was also indicted for not opening the heart walls of its trap in Prince of Wales Passage during the weekly close season on August 15. The cases will not be tried until 1921.

On July 27 the Bristol Bay Packing Co. was accused in a complaint made in the United States commissioner's court at Koggiung of fishing on July 5 with a gill net in Naknek River, contrary to the closing order of December 18, 1920. A plea of guilty was entered and a fine of \$38.60, being the costs of the prosecution, was imposed.

On July 28 another complaint, charging that two boats belonging to the Bristol Bay Packing Co. and the Red Salmon Canning Co. were fishing in Naknek River on the night of July 12, was entered before the commissioner at Koggiung. The accused pleaded guilty and were fined the costs of the prosecution, amounting to \$66.60.

On July 29 a complaint filed before the commissioner at Koggiung alleged that the Alaska Packers Association had fished with a drift gill net in Naknek River on July 5. When the case was called a plea of guilty was entered, and a fine of \$10 and costs of \$43.60 was imposed.

The Circuit Court of Appeals of the Ninth Circuit, sitting at San Francisco, affirmed the sentence and judgment imposed on the Canoe Pass Packing Co. and the Northwestern Fisheries Co., jointly indicted in October, 1918, and convicted in the district court at Valdez in October, 1919. These companies were indicted on four violations of the regulations affecting fishing in Copper River by having set four nets in Miles Lake, which is a part of the river, within the prohibited distance of other nets previously set. The trial court imposed a fine of \$1,000 and costs against each company, or \$250 for each count in the indictment.

TERRITORIAL TAX LAW UPHELD.

In October, 1919, an action was brought in the Supreme Court of the United States on writ of error from a judgment of the District Court for the District of Alaska, Division Number One, dismissing the suit of the Alaska Fish Salting & By-Products Co., plaintiff in error, against Walstein G. Smith, treasurer of Alaska, defendant in error, to recover money paid as taxes by the plaintiff to the defendant for the tax years 1917 and 1918 under chapter 74, Alaska Session Laws, 1917, enacted by the Alaska Territorial Legislature.

There were originally two suits. The first one was brought in 1918 to recover the 1917 tax of \$2 per barrel on 4,112 barrels of fish

oil, amounting to \$8,224, and the tax of \$2 per ton on 1,037 tons of fish meal, amounting to \$2,074, making a total tax of \$10,298, for which judgment was asked, together with interest thereon at 8 per cent per annum from January 14, 1918. The second suit, for 1918 taxes, was filed on February 17, 1919, to recover the tax of \$2 per barrel on 2,720 barrels of fish oil, amounting to \$5,440, and the tax of \$2 per ton on 645 tons of fish meal, amounting to \$1,290, making a total tax of \$6,730, for which judgment was asked, together with interest thereon at 8 per cent per annum from January 15, 1919.

Eight assignments of error were presented and based on the action of the trial court in sustaining demurrers, dismissing the complaints, denying plaintiff's motion for judgment, and rendering judgment against the plaintiff, and thus upholding the constitutionality and validity of the act of the Territorial Legislature and the taxes imposed thereby. The plaintiff company, through its attorney, filed a brief before the United States Supreme Court on December 2, 1920, setting forth at length the contention that the legislation imposing the tax, to avoid which this litigation was had, contravened and violated the Constitution of the United States, particularly the fifth and fourteenth amendments, in that the plaintiff was denied the equal protection of the law and was deprived of its liberty and property without the process of law; that the legislative classification of plaintiff's business was so arbitrary and unreasonable as to constitute class legislation, and that the tax was confiscatory and prohibitive, and that it was not laid on other businesses or industries which were essentially the same as plaintiff's business; that the legislation was a clear abuse of the Territory's legislative authority, and that it accomplished, by means of an intentionally arbitrary and confiscatory exaction imposed under the guise of a tax, the unauthorized destruction and confiscation of a lawful pursuit; that the legislation was a clear, arbitrary discrimination against the manufacture of fish oil and fish meal from herring in whole or in part, although there was no reasonable distinction between that business and other businesses in all essentials similar thereto carried on in Alaska upon which no tax whatsoever was laid; that the legislation, if deemed to be a police regulation, was unreasonable and unauthorized, as Congress had expressly reserved police supervision and control of the fisheries to itself; that the legislation was extortionate, unfair, and prohibitive, and so confiscatory as to result in a tax of 113.64 per cent of the net profits for one year; and that the legislation and the taxes imposed thereby violated the Alaska Organic Act in that they were not uniform on all occupations or businesses, nor were they uniform on all businesses of the same class; that the tax exceeded 1 per cent of the actual value of plaintiff's property, and that it was not levied or assessed on the actual value of the property, but was purely an arbitrary imposition in utter violation of the constitutional limitations of the Alaska Organic Act.

On January 31, 1921, the Supreme Court handed down a decision affirming the judgment of the trial court. In view of its interest to the fishery industry of Alaska the opinion is here quoted in full, as follows:

This is an action to recover the amount of taxes levied under statutes of Alaska which the plaintiff alleges to be contrary to the act of Congress of August 24,

1912, c. 387, § 3, 37 Stat. 512, creating a legislative assembly in the Territory of Alaska, and to the Constitution of the United States. Judgment was given for the defendant upon demurrer to the complaint, the parties agreeing that the foregoing grounds of recovery were the only matters in dispute. The statutes attacked, viz: May 1, 1913, April 29, 1915, and May 3, 1917, levy license taxes of two dollars a barrel and two dollars a ton respectively, upon persons manufacturing fish oil, fertilizer and fish meal in whole or in part from herring. The Act of Congress after giving effect to the Constitution and laws of the United States in the Territory provides that the authority therein granted to the legislature "to alter, amend, modify, and repeal laws in force in Alaska shall not extend to the * * * fish * * * laws * * * of the United States applicable to Alaska, or to the laws of the United States providing for taxes on business and trade * * * *Provided further*, that this provision shall not operate to prevent the legislature from imposing other and additional taxes or licenses." Some reliance is placed also upon § 9 that all taxes shall be uniform upon the same class of subjects, &c., and that no tax shall be levied for territorial purposes in excess of one per centum upon the assessed valuation of property therein in any one year.

The complainant alleges that the tax will prohibit and confiscate the plaintiff's business, which is that of manufacturing fish oil, fertilizer, fish meal and by-products from herring either in whole or in part; that the tax unreasonably discriminates against the plaintiff, as it levies no tax upon the producers of fish oil, &c., from other fish, and is otherwise extortionate; and that it contravenes the Act of Congress in lack of uniformity and in exceeding one per centum of the actual value of the plaintiff's property. The prophecies of destruction and the allegations of discrimination as compared with similar manufactures from salmon are denied by the Attorney General for Alaska, the latter denial being based upon a comparison of the statutes which of course is open. We are content however to assume for the purposes of decision that, not to speak of other licenses, the questioned Acts do bear more heavily upon the use of herring for oil and fertilizer than they do upon the use of other fish. But there is nothing in the Constitution to hinder that. If Alaska deems it for its welfare to discourage the destruction of herring for manure and to preserve them for food for man or for salmon, and to that end imposes a greater tax upon that part of the plaintiff's industry than upon similar use of other fish or of the offal of salmon, it hardly can be said to be contravening a Constitution that has known protective tariffs for a hundred years. *Rast v. Van Deman & Lewis Co.*, 240 U. S. 342, 357. Even if the tax should destroy a business it would not be made invalid or require compensation upon that ground alone. Those who enter upon a business take that risk. *McCray v. United States*, 195 U. S. 27. See *Quong Wing v. Kirkendall*, 223 U. S. 59; *Mugler v. Kansas*, 123 U. S. 623; *Louisville & Nashville R. R. Co. v. Mottley*, 219 U. S. 467, 482. We need not consider whether abuses of the power might go to such a point as to transcend it, for we have not such a case before us. The Acts must be judged by their contents not by the allegations as to their purpose in the complaint. We know of no objection to exacting a discouraging rate as the alternative to giving up a business, when the legislature has the full power of taxation. The case is different from those where the power to tax is limited to inspection fees and the like, as in *Postal Telegraph & Cable Co. v. Taylor*, 192 U. S. 64, 72.

But it is said that however it may be with regard to the Constitution taken by itself, the statutes brought into question are contrary to the Act of Congress from which the local legislature derives its power. In the first place they are said to be an attempt to modify or repeal the fish laws of the United States. The Act of Congress of June 6, 1900, c. 786, § 29; 31 Stat. 321, 331; Alaska Compiled Laws, § 2569; imposes a tax on fish oil works of ten cents per barrel and on fertilizer works of twenty cents per ton, repeated in slightly different words by the Act of June 26, 1906, c. 3547; 34 Stat. 478; Alaska Compiled Laws, § 259. But these are not fish laws as we understand the phrase. It is argued, however, that at least they import a license, *License Tax Cases*, 5 Wall. 462, 470, and that a tax alleged to be prohibitory flies in their teeth. It would be going far to say that a tax on fish oil works in general terms imported a license to a specific kind of works deemed undesirable by the local powers, and when we take into account the express and unlimited authority to impose additional taxes and licenses we are satisfied that the objection should not prevail. We confine our decision to the statutes before us, repeating in this connection that

they must be judged by their contents not by the characterization of them in the complaint.

The requirement of uniformity in § 9 is disposed of by what we have said of the classification when considered with reference to the Constitution. The legislature was warranted in treating the making of oil and fertilizer from herring as a different class of subjects from the making of the same from salmon offal. The provisions against taxing in excess of one per centum of the assessed valuation of property does not apply to a license tax like this. This is not a property tax, *Alaska Pacific Fisheries v. Territory of Alaska*, 236 Fed. Rep. 52, 61. The objection that the plaintiff in error is doubly taxed, first by the United States and then by the Territory, is answered by the express authority to levy additional taxes to which we have referred heretofore. Without going into more detail we are of opinion that the tax must be sustained.

ROBBERY OF FISH TRAPS.

The fishing season of 1920 was marked by a renewal in southeast Alaska of the piratical operations of 1919, which caused the packers considerable loss of salmon. The regions chiefly affected were the Cape Fox district, Craig and vicinity, Icy Strait, and the northern part of Chatham Strait. The first robberies were reported in June, and from that time until the middle of August depredations occurred at short intervals. Calls for assistance in putting down the disorder were made to officials of the district court and to the governor of Alaska, who was instrumental in securing the presence in Alaskan waters of certain vessels of the Navy, supposedly for the better enforcement of all laws and especially the suppression of this particular form of lawlessness.

Subchaser *No. 294* was almost constantly engaged in patrolling the southern districts while subchaser *No. 310* made infrequent cruises into the northern localities. But with all these activities the unlawful taking of salmon was not stopped thereby. In September information was presented by one packing company to the grand jury at Juneau which indicted four men who had operated in the Icy and Chatham Straits region, but when the case came on for trial it was dismissed against three of them for lack of sufficient evidence while the other one was tried and acquitted.

Investigation has shown that much of this so-called piracy was the purchase of salmon from dishonest trap watchmen. Negotiations were unsuccessful when they were undertaken with faithful, upright watchmen. In some instances salmon were taken from unwatched traps, but the number so secured must have been small, as all traps making even fair catches of salmon were watched by one or more men.

Of further interest in this connection is the fact that salmon were taken chiefly from floating traps, owing to the ease with which fish could be removed from such apparatus, there being no material change of conditions at any stage of the tide. With but occasional exceptions, it is improbable that more than a few hundred salmon were taken or purchased at any one time, for the boats engaged in the business were small and manned by very few men. Most reports of large losses of salmon from this cause must be regarded as exaggerated, for in view of the scarcity of salmon many traps making even moderate catches were carefully guarded by reliable employees, who in some instances are said to have easily frightened away would-be thieves by the discharge of firearms.

In the last analysis, the suppression of this business appears to be almost wholly in the hands of the cannerymen and the operators of traps themselves. It seems reasonable to conclude that refusal to purchase salmon from suspicious sources and the employment of honest watchmen will make it unprofitable and cause the entire cessation of the reprehensible practice.

TERRITORIAL FISH COMMISSION.

The Alaska Territorial Fish Commission was created by the legislature at its session early in 1919, and at the same time the sum of \$80,000 was appropriated for its work during the ensuing biennium. The efforts of the commission have been devoted chiefly to fish-cultural work, the removal of natural barriers in salmon streams, and the destruction of predatory trout. The commission has issued two printed reports covering its activities during each of the two years ending March 31. According to the report for the biennium ending March 31, 1921, there was expended in the first year \$27,901.24, and in the second year \$40,143.66, thus leaving an unexpended balance of \$11,955.10. Of the \$27,901.24 expended in the first year, \$12,072.08 was spent for fish-cultural work, \$6,373.98 for stream improvement, and the balance for general expenses, permanent improvements, etc. Of the \$40,143.66 spent in the second half of the biennium, \$16,573.71 was chargeable to propagation and \$19,695.90 to stream improvement and the destruction of predatory fish, the balance going for general expenses.

According to the reports of the commission, stream improvement work in 1919 was accomplished as follows: Juneau district, seven streams; Ketchikan district, eight; Cordova district, three; and Seward district, three. In 1920 this work was upon a more extensive scale, being reported as follows: Juneau district, seven streams; Ketchikan district, various streams south of Wrangell Narrows, number not stated; Cordova district, five; and Seward district, eight. It is reported also that in the Juneau district 10,000 predatory fish were destroyed, and in the Cordova district 13,648 were destroyed. Mention is made also of the destruction of a considerable number of predatory fish in the Bristol Bay district. Figures in respect to this, however, are covered by the report by Dennis Winn, field superintendent of fish-cultural work for the Bureau, appearing on page 31. The Territory contributed \$2,000 toward the fund for conducting this work in Bristol Bay.

Details as to the fish-cultural and hatchery work of the commission will be found in the section of this report devoted to hatcheries.

TERRITORIAL LICENSE TAX.

Under the laws of Alaska a tax is levied on certain fishery products and apparatus, and it is payable annually to the treasurer of Alaska. On May 11, 1921, the treasurer furnished a statement showing the collections as made to that date for the fiscal year ending December 31, 1920. As compared with collections for 1919, the revenues of the Territory fell off \$51,901.14, which amount is almost covered, however, by delinquent taxes for 1920.

FISHERY LICENSE TAXES COLLECTED BY TERRITORY FOR FISCAL YEAR ENDED DEC. 31, 1920.

Schedule.	Division No. 1.	Division No. 2.	Division No. 3.	Total.
Salmon canneries.....	\$52,460.26	\$1,260.94	\$88,474.61	\$142,195.81
Herring canneries.....	71.95		.10	72.05
Clam canneries.....	3.58		58.48	62.06
Salteries and mild-cure plants.....	923.73	123.25	4,625.14	5,672.12
Fish traps.....	55,800.00		23,500.00	79,300.00
Fish-oil works and fertilizer and fish-meal plants.....	18,199.73		1,168.00	19,287.73
Cold-storage plants.....	1,500.00		510.00	2,010.00
Whale-oil plants.....			100.00	100.00
Total.....	128,879.25	1,384.19	118,436.33	248,699.77
Additional tax ¹				700.66
Delinquent whale products tax.....				21,695.00
Estimated delinquent canned salmon tax.....				30,000.00
Grand total.....				301,095.43

¹ Additional tax of 1 per cent of their annual net incomes collected from salmon canneries (not possible to segregate by divisions).

DESTRUCTION OF PREDATORY FISHES IN BRISTOL BAY REGION.

During the season of 1920 the Bureau cooperated with salmon packers in the Bristol Bay region by organizing a force for the destruction of predatory fishes in certain waters of the district. Part of the expenses of the expedition were paid from a fund made up by the fishery companies and the governor of Alaska. Field Superintendent Dennis Winn, of the Bureau's fish-cultural service, was in charge of the work. Mr. Winn's report is as follows:

In Seattle equipment was purchased and the services secured of J. W. Gardner, a practical fish-culturist, of the Bureau of Fisheries; A. T. Loeff, of the College of Fisheries, University of Washington, who has had considerable experience in commercial fishing; and Harry Savage, a practical fisherman. All proved excellent men for the work to which they were assigned. Men and equipment were transported from Seattle on the *Libby Maine*, which vessel arrived at Bristol Bay on May 25, and we were put ashore at Libbyville the same evening.

Our equipment was taken ashore at the cannery of the Naknek Packing Co. the evening of June 4, and the following morning we moved the entire equipment with supplies to the cannery of the Alaska-Portland Packers' Association farther up the Naknek River, where it was divided into three lots, one for each location to be operated. Camps were established on the Upper Naknek River, Lake Aleknagik, and Iliamna Lake. Mr. Loeff was in charge of the crew at Naknek, Mr. Savage at Aleknagik, and Mr. Gardner at Iliamna. Each camp was moved several times in order to facilitate the work, as local conditions and possibilities were recognized.

NAKNEK SECTION.

Mr. Loeff, taking with him his portion of the equipment, one white man and two Indians, was immediately transferred upriver, where camp was established that evening about 2 miles below the foot of the rapids. His operations extended from the rapids to about 5 miles below the camp, near the mouth of Ralph River. But few trout were observed below that point. A spoon troll was used en route to the camp site, and several steelheads and one lake trout were caught, all above Ralph River.

In making a survey of the vicinity we found we were late for the migrating salmon, arriving at the latter end of the period, which extended only through the month of May and early June. Good numbers of lake trout, however, were taken in the vicinity of our camp, these weighing from 6 to 12 pounds, and all had fish in their stomachs—young salmon, smelts, and whitefish. It is safe to

say that this species is as detrimental to the salmon industry as is the Dolly Varden, if not more so. One specimen was taken with two whitefish over 12 inches in length in its stomach without distending it. The trout follow the migrating salmon to tidewater and gradually work back into the lake when the young salmon have passed. We found this species distributed through the entire main river above Ralph River and up through the rapids into the lake, but not in extremely large numbers. Steelhead trout were more abundant in the river, as were also grayling and whitefish, the latter, especially, appearing in great numbers.

After the river was thoroughly cleared in the vicinity of our operations camp was moved to the lake outlet, where fair numbers were taken, but, owing to the difficulties of seining and to the salmon ascending, a survey was made of the entire lake with a view to finding more suitable operating points. Camp was finally located at the mouth of Kidawik Creek, on the south side of the lake near the entrance to the east arm, where good numbers of lake trout and some Dolly Vardens were taken. The lake entrance would be an excellent location when the young salmon are descending early in the season, but none were in evidence at that date, June 17.

Practically all the fish entering Naknek Lake either pass up Kidawik Creek or Simenoffsky River at the extreme head of the east arm. The lake shore, with the exception of a few miles along the south shore, offers no inducement for spawning fish owing to the amount of ashes accumulated from the eruption of 1912 distributed along the shore line. All other tributaries are thickly impregnated with ashes. While our arrival was late and help of little account, about 16,600 pounds were destroyed, mostly lake trout.

Kidawik Creek is an ideal salmon stream with fine spawning bottom its entire length of about 2 miles. It connects Naknek Lake with Toms Lake, which is 12 by 4 miles in extent, the greater portion being clear and suitable for spawning grounds. About midway between the two lakes there is a waterfall from 5 to 8 feet high, over which it would be impossible for fish to ascend during low-water stage. It is a stone shelf of volcanic formation extending clear across the river, and, having no powder, we felt that a cut could be made with steel bars, etc. We therefore secured several stone-cutting gads, a steel bar, top maul, hammer and pick, and, after diverting the flow of water near one side of the stream, a cut was made 10 feet in width, sloping back about 15 feet, through which the fish could easily pass.

The salmon made their appearance in the mouth of the creek July 8, the number increasing gradually. A good run entered July 15, which was the date the cut was complete. There were fair numbers that found and passed through the cut, but the majority worked continuously at the center of the fall, many being injured and floating downstream. As the water rose, some of the fish were noticed passing over the top of the dam, and with high water they had no trouble in passing over. The cut makes it possible for them to ascend at any time. Fishing at this point was conducted in conjunction with the work of making a passageway through the dam. The trout taken were chopped fine and used to bait certain suitable seining points, where the fish gathered in numbers, and a seine was slipped around them.

As this point was the only one where the fish could be observed, owing to the murky water, we endeavored to keep a check on the new arrivals from day to day in order to estimate the approximate escapement. From such observations it is estimated that about 150,000 fish entered the lake. This estimate must of necessity be rough, as the water was so badly discolored. There was no way by which we could intelligently estimate the number entering Simenoffsky River, as the water at that point was thick with ashes, but indications were of less fish than at Kidawik, and an average was accepted of from one-half to two-thirds. This would place the total escapement at the figure mentioned, which we consider as near an average as could be secured with our opportunities.

On two occasions the camp was visited by bears, when all the crew were absent, and the tent was slashed down the side. While bears were observed from time to time in the vicinity, none of the men was ever threatened.

WOOD RIVER SECTION.

On the evening of June 8, accompanied by Mr. Savage and another white man, I left on the Alaska-Portland Packers' Association boat *North King*, en route to Lake Aleknagik. We arrived at Dillingham the morning of the 9th,

where supplies were purchased and the services engaged of two natives to assist Mr. Savage. However, we were forced to discharge these men after three days' service. One native was later secured who qualified and remained to the completion of the work at that point.

Men and equipment were transferred from Dillingham on the Alaska-Portland Packers' Association power boat *Ekuk* to Lake Aleknagik, where camp was established June 10 at the lake outlet. A survey was made of this lake to determine its possibilities for trout operations. It was learned that the only suitable places lay at the lake outlet and the mouth of the river between Aleknagik and Nerka lakes.

Set and drift gill nets, in connection with seine and troll lines, were used and the early work centered at the lake outlet, where a considerable number of Dolly Vardens were taken, weighing from two to seven pounds each. The stomachs of these fish were all well filled with migrating salmon, Nos. 2½ and 3 in size, 25 or more young salmon being counted in a stomach. The habits of the trout were observed closely. It was noticed that they met the salmon schools at the inlet and outlet of the lake, where the bar drops off into deep water, a certain number of trout accompanying and feeding on the salmon.

In connection with the Dolly Vardens working on the young salmon in deep water, the terns are almost equally severe at the surface. The salmon migrate in enormous schools, making them easy prey for trout, and the work of the latter forces the young salmon to the surface, where the terns take their toll. Large flocks of from 500 to 1,000 were noticed actively feeding whenever a school passed certain points. After several days' operations at the lake outlet the catch of trout became almost negligible, and it was noticed that while the terns were present in large numbers and would become excited and active on sighting a school of young salmon, their success in catching was materially lessened, the fish not coming close enough to the surface. No trout other than Dolly Vardens were taken in this section, and very few under 2 pounds were captured. All averaged 3 and 4 pounds, and specimens weighing 7 pounds were common.

Through the courtesy of Capt. Williams, of the Alaska Packers Association, we were supplied with a tally scow, and, with the assistance of Mr. Daly, of the Alaska-Portland Packers' Association, this scow was towed into the lake. We were comfortably housed and easily moved. When the trout became scarce at the lake outlet the camp was moved to the upper end of the lake, where the scow was placed in the mouth of the river connecting with Nerka Lake. At this point good results were secured, and it was here that the bulk of the trout was taken. It is estimated that from 35,000 to 40,000 pounds of trout were destroyed. Many were diseased, wormy, and emaciated, but always ready to feed.

The migrating season of salmon in this district extends over a period of about three months, and, figuring an average of 15 to 20 migrating salmon for each trout per day—which represents but one feed for the average trout taken—the number of trout destroyed would mean a saving of more yearling salmon than could be handled in any of our hatcheries during a season, not to mention the expense of feeding, etc., and this without taking into consideration the serious depredations of the terns.

Our point of vantage in the scow enabled us to keep a close tally on the adult salmon ascending to the spawning grounds, together with the proportion of loss from fungus growth, due to gill-net injuries. No large run of salmon was ever observed ascending, but a steady line was noticed from July 5 to July 20, gradually tapering off to small numbers at the date of our departure, July 28. Some were noted ascending prior to July 5, but in negligible numbers. As consistent a check as possible was kept on the ascending fish. The salmon came along the shore of the lake, entered the river, and passed into the strong river current in the rear of our scow, where the current and scow created smooth water. Dolly Varden trout as large as the salmon were noticed passing upstream with the latter in a ratio of about 2 to 4 per cent. As no small trout were taken throughout the season it is believed that all spawn in the upper lakes. Those taken by us were principally sea-run fish. It was impossible to use gill nets without injury to the salmon, and the trout operating in deep water made it necessary to devise some other means of capture. Mr. Savage devised a mold in the shape of a fish, and this was poured full of lead over the stem of a large, long-shank fishhook, which was used as a troll and

fished among the migrating salmon. With this crude device two men succeeded in taking $1\frac{1}{2}$ tons of trout in one day. As fishing continued the numbers taken gradually decreased several hundred pounds each day to the time of our departure, when the best capture possible was from 300 to 1,000 pounds per day.

A check was made from time to time, in 5-minute periods, on the numbers of salmon ascending during the height of the run, and it was estimated that about 400,000 fish passed upstream during the period of 20 days. This constituted the run, figuring a steady escapement during the whole 24-hour day. This figure, while not absolutely correct, we feel is as close an estimate as can be made under the circumstances.

The salmon afflicted with fungus were closely checked by myself and each employee individually, and we estimated that 5 per cent unable to swim the current in the river would die in the lower lake in a very short time. A wound caused by gill nets in salt water rapidly becomes covered with fungus after the fish enters fresh water. When the fish is badly cut the wound putrefies rapidly, and on arrival at the head of the first lake there will be a circle of fungus one-half inch or more in depth and several inches wide around the body of the fish. Another 5 per cent were noticed with numerous gill-net marks around the body, but in these the fungus was not in an advanced stage. However, while these fish have strength to ascend the river, I am positive that few, if any, ever reach the spawning stage.

KVICHAK AND ILLAMNA SECTION.

It was planned to operate early on the Kvichak River, but owing to the impossibility of securing help and an accident to one of our boats en route, which was repaired at the cannery of the Alaska-Portland Packers' Association, that plan was necessarily abandoned.

For various reasons it was impossible for Mr. Gardner, who had his equipment assembled at Naknek, to reach the Iliamna district before June 27, and at that date the water was extremely high in the streams with occasional floods overflowing the banks. Very little help was possible, but every effort was made with gill nets; seines could not be used owing to the high water. Good work was accomplished by Mr. Gardner under discouraging conditions.

The writer divided his time between the Wood River and Naknek fields until it was necessary for employees at those points to discontinue work, owing to the departure of cannery boats on which they had passage to the States; then he proceeded to Iliamna, arriving August 10. On the Iliamna River, where our first camp was established, but few large trout were taken, and those mostly at the mouth of the river in the lake. All taken here were Dolly Vardens, with the exception of a few steelhead trout and whitefish. The high water had the effect of scattering the schools and but small numbers were noticed gathering in the pools. The trout, unlike those captured in other localities, were long and slender, which made it impossible to gill many in our nets, and, moreover, the ascent of the salmon necessitated the removal of the nets from the water so as to prevent injuring the ascending salmon.

As the water receded the trout were noticed schooling in the eddies. Traps were improvised, about 5 feet long and 2 feet in diameter, from wooden hoops covered with chicken wire, with an opening in one end similar to the opening in lobster pots. These traps were baited and set in the pools where they caught many thousand fish. In the first one set we took 150 fish in two hours. Many worked through the wire mesh, necessitating doubling the wire screen, thus making the mesh smaller, and no further trouble was experienced. These bait traps have the advantage of catching the predatory fish without in any way attracting or interfering with the salmon. They can also be fished in any water and are efficient up to the time of active spawning.

The people in the vicinity were impressed with these traps and wished to use this method in their own fishing. Therefore, on our departure, we distributed the traps on hand and supplied the other residents with material to make one or two each.

After the pools in the vicinity were cleared of trout, which work was accomplished in short order without interfering with the salmon, it became necessary to seek new locations for operations, and the near-by creeks and rivers were examined with this end in view, and also to obtain all salmon data possible.

In accordance with previous plans, we arranged to proceed to Lake Clark, arriving at the portage between Iliamna Lake and Newhalen River on August

21, where we were storm bound for several days. Supplies and equipment were packed over the portage mainly by myself and assistants, as the Indian packers who perform this kind of work are absolutely undependable, especially as they had considerable money from the summer's work at the canneries, and most of their time was occupied in celebrating. We proceeded upriver en route to Lake Clark on August 28. We learned from natives and prospectors that no Dolly Varden trout are ever taken in Lake Clark, and that there is but one stream in that locality which is inhabited by this species, namely, Kegik Creek.

A thorough survey was made of the entire lake and tributaries, our party passing up the east shore and returning on the opposite side. No trout in quantities were observed, and the possibilities of stream spawning were found to be very limited. It was noticed that the salmon spawn earliest near the outlet of the lake and later as they proceed up the lake. The prospectors and natives were fishing the mouths of the creeks and also directly on the spawning grounds preparing dog feed. Streams were visited in the following order:

Tazimina River is an ideal salmon stream with suitable sloughs for spawning red salmon, but not more than 50 were noticed. A high waterfall about 5 miles from the mouth blocks the ascent of fish.

Tarnalia River is a good stream but contained no salmon. We were advised by prospectors living at its mouth that few salmon ever enter, even in good years. There are falls about 4 miles up and no fish above.

Current Creek is a good spawning stream for the first mile, but unsuitable farther up. It contained no fish.

A small creek at the head of Little Lake Clark could accommodate fair numbers, which are in evidence in good years, but none have appeared for the last two seasons.

Big River, at the junction of Big and Little Lake Clark, is the largest stream tributary to the lake. It is glacial fed and few salmon ever enter.

Portage Creek is small, with no possibilities.

Kegik Creek is a fair-sized stream with good possibilities. It has a lake at its head and is recognized as the best salmon stream in that locality, the fish ascending into the lake. A trip was made to the lake and but few salmon noticed, none being found in the small tributaries at its head which are thoroughly suitable for spawning. I was advised by prospectors in the vicinity that some spawning red salmon were noticed in the lake in December and spawned-out fish still active in January of some years, which would indicate an extremely late run.

Chulitna River has no salmon possibilities. It is a shallow river and heads in a marsh containing large numbers of plke.

Practically all the salmon spawn along the shore of the lake and nearly the entire shore is suitable. Many miles of ideal spawning grounds were noticed along the lake shore. The Indian fish villages, now deserted, scattered along gave positive evidence as to the best spawning locations in former years. Lake trout, especially during the spring months, are numerous and easily taken; specimens reported weighing 40 pounds or more were common. Very little use is ever made of them by the natives, and only in emergency cases are they ever considered. As our time was limited and lake trout were not abundant, we continued back to Iliamna and finished the season with a survey of that lake, with the exception of the west shore, which was too dangerous at that time of year to undertake in a small boat.

The Newhalen River, which connects Iliamna Lake and Lake Clark, has a series of falls and rapids about 2 miles from its mouth, but these are not of sufficient size to hinder the ascent of the fish. The formation, however, renders it easy for the Indians to catch their supply with large hooks on the end of long poles, as the fish must of necessity pass through certain small channels between the rocks. The rapids are about 500 yards long, passing through narrow channels at the upper end and widening to about 300 feet in rapids below, which end in a further widening of the river to about one-half mile. This portion of the river is shallow for about one-quarter of a mile, with ideal spawning bottom, on which some fish were spawning. The major portion of the fish taken by the natives in this locality were captured either in the rapids or on these spawning grounds.

The channel between the river and Iliamna Lake is about 200 yards wide and broadens immediately on entering the river to about one-half mile. This channel

would be an ideal place for the capture of trout with any kind of gear through the spring months.

A good run of salmon was found in Kokhonak Creek, with the usual native family catching them on the spawning beds and drying them as food for the family and dogs. Here we captured a number of steelhead trout in nets, and great numbers were noticed on the beds with salmon, feeding on their eggs. No Dolly Vardens were taken or seen. A trip was made to the lake at the head of the stream, a distance of 6 miles, and it was observed that the stream was well seeded the entire way. The stomachs of the fish taken at this point were filled with decomposed salmon and spawn, and on account of the unlimited supply our bait traps did not appeal.

All streams in Kokhonak Bay were visited, but no fish were noticed in any streams other than Kokhonak Creek and Kokhonak River. A fall 20 feet high in the mouth of Kokhonak River prevents the ascent of fish. From 400 to 500 red salmon were observed endeavoring to pass over this obstruction, but they could not proceed over halfway. It was believed that after being unsuccessful in negotiating the falls they would drop back and spawn. After careful search they were located spawning about 100 feet from the falls, close to a straight rock bluff, in 9 feet of water, and between large bowlders where there were suitable gravel spots. Some lingcod and steelhead trout were observed working in the beds for eggs, and each specimen taken had salmon eggs in its stomach. An efficient fishway can be installed at small expense, providing it is undertaken in the spring, when the water is low. Its installation would open miles of perfect spawning area in the river, and would also permit the fish to pass up as far as Kokhonak Lake. This river is one of the best streams for salmon tributary to Iliamna Lake.

On the Iliamna River trips of observation were made about 12 miles upstream, the first on August 14, when not over 1,000 salmon were seen on the beds; on the second trip, September 17, no salmon were noticed in localities visited in August, but about 500 were found spawning 4 miles from camp. These represented the entire run in Iliamna River for the season. There was always a sprinkling of Dolly Vardens with the salmon, some of them spawning, but they were so scattered as to render capture in any numbers impossible.

Pile River was not visited, but the natives reported no fish there.

A fair run of fish entered Chekok River, from which the majority of the natives in the Iliamna River district obtained most of their fish supply.

The last few days in the field were spent at Iliamna, where we set bait traps and caught several hundred Dolly Vardens, thereby again clearing the pools.

SUMMARY.

Our work was severely handicapped owing to late arrival, the impossibility of securing suitable help, and the necessity of familiarizing ourselves with conditions, each locality having a distinct problem to solve in the capture of trout. We were compelled to pay top wages for native help, and most of the natives were worthless, necessitating their discharge at the earliest moment possible without embarrassment to the work. At no time was suitable help available, except at Iliamna late in the season after the canneries had closed. Our equipment, too, was inadequate; while we expected that gill nets of 3-inch and 3½-inch mesh would be suitable, we found the trout usually too large to gill.

Our experience this year will enable us to wage an extensive and aggressive campaign another season. At Naknek the work can be best accomplished in the early spring months, or up to the time salmon enter the stream. After this, if desirable, some of the operators could be used as stream watchmen through the cannery season. In the Aleknagik Lake section excellent results could be obtained throughout the entire season, or until the canneries close, necessitating departure. Good work can be accomplished in the Iliamna district up to the period of spawning, or the middle of August.

The salmon run was spasmodic in all but the Wood River section, but at no time were there indications of an abundance of salmon in any portion of the districts operated. While the escapement into Wood and Naknek Rivers was greater than that of the previous year, a greatly insufficient number reached the spawning grounds to insure a normal pack and allow sufficient escapement for the future. Our judgment would indicate a totally inadequate supply for even a small year, to say nothing of normal.

In the Kvichak and Iliamna sections the spawning beds were nearly destitute of spawning salmon. I am positive that the storms, which interfered some-

what with the commercial catch, were the salvation of the situation, for if but a slightly increased pack had been made the escapement would have been practically nil and the beds would have been left nearly or wholly bare, with an absolutely discouraging outlook for the future.

We are thoroughly convinced that the predatory fishes, together with the terns mentioned heretofore, constitute one of the most serious menaces facing the salmon industry. In small years, such as 1919 and 1920, they will practically eliminate the cycle runs by their depredations, first on the eggs on the spawning beds, next on the young fish in the first year or two spent in the lakes, and last, but not least, on the migrating fish descending to the ocean. The only hope of curtailing this loss is by waging a constant, aggressive and extensive campaign against these marauders. In the performance of this work a close tally can be kept on the escapement and spawning grounds, which is the only method by which the industry can be advised with any degree of assurance and safety. Our work of extermination this year will surely be of invaluable aid to the future, and its continuance with an enlarged scope will show its value within the next cycle. We also feel at this time that it is one of the greatest hopes for the industrial future of the salmon industry.

RECOMMENDATIONS.

I would respectfully recommend that this work be continued on as extensive a scale as possible for the elimination of predatory fishes and birds.

I recommend the purchase of three power boats of Columbia River type, one for each section operated, with living quarters aboard for three or four people. They would facilitate the work of transferring crews to different localities, and it would not then be necessary to embarrass the different cannery superintendents with requests for the use of a launch when same is needed for cannery work. It would also insure comfortable living and sleeping quarters for the crew and thus eliminate the discomforts of tents and sleeping on the ground, which is nearly impossible in that section during heavy rains. With such a boat many localities could be profitably operated with seines, set and gill nets, and bait traps, necessitating but a small crew at any point of operation. Such a boat would also be of special value to stream watchmen. As efficient work at the different points would cease at about the time the commercial season began, I would suggest that the boats be utilized by some of our men who would be employed as stream watchmen.

Good work can be effectively continued with jigger trolls and bait traps during the period the salmon are running. A small crew can profitably operate as much of this gear as can be efficiently utilized, thus releasing a portion of the crew with the power boats for stream police duty without detriment to the predatory fish work.

Three new 20-foot fishing skiffs are needed, together with several gill nets of large mesh, and material for making a number of bait traps, and three larger and deeper seines, one for each locality. These added to our present equipment will meet any emergency pertaining to our work as outlined.

I would further recommend that employees be engaged in the States and that they reach the different localities in Bristol Bay as early as possible in the spring months. They should be on the first boats reaching the region. Employees should go to the Upper Iliamna by the regular steamship line to Cook Inlet, thence to Iliamna Bay and Iliamna village, arriving about May 1. At that time the water is low and the trout schooling in large numbers. Seines can then be used to advantage, also the bait traps and gill nets. The necessity of reaching Iliamna by Cook Inlet is due to the fact that passage can not be made from Bristol Bay through the lower end of Iliamna Lake before late in the season owing to the ice in that locality.

A fishway should be installed in Kokhonak River.

These recommendations are made to meet conditions as they exist in the sections operated this season, but they can be enlarged in accordance with any plan formulated to broaden the scope of the work.

AFOGNAK RESERVATION.

Historical data have been published year after year showing the establishment of the Afognak Fishery Reservation by presidential proclamation in 1892 and the object that was hoped to be attained

by its creation. From the date of the establishment of the reserve until the spring of 1912 all commercial fishing in Afognak waters was prohibited, but the order was not obeyed and no attempt was made to enforce it. Though those waters were nominally closed to all commercial fishing and the two canneries on Litnik Bay suspended operations and were dismantled and sold, pickling operations were carried on by local parties at the most important streams of the island until 1912, when by departmental order the reservation was opened to the native inhabitants of the region under such terms and conditions as seemed necessary to safeguard the runs of salmon. Although the fishery resources of Afognak were well known, the mere fact that fishing was authorized coincident with the opening of a salmon cannery at Kodiak was sufficient inducement for the entire native population of the island to seek and secure fishing privileges. The legalization of fishing did not, however, increase the supply of salmon in those waters, though on the face of returns that might appear to have been the case. The catch in 1912 was larger than any year since 1892, but it was so for no other reason than that more fishing was done. Yet, on the whole, results were disappointing, and it was early apparent that the island fisheries alone could not support the natives of Afognak. It was further evident, after a few seasons had passed, that the salmon runs would suffer serious depletion if the original scale of operations was allowed to continue. Accordingly a limit was placed on the number of fishermen, who were divided into small gangs, to each of which certain fishing grounds were assigned. Experience taught that where unnecessary numbers of fishermen congregate at one place fishing is much more intensive. This evil was easily corrected by limiting the number of men who might operate at each place and by shortening the fishing season. Authority was therefore given that not to exceed 55 natives were to be licensed to fish in Afognak waters in 1920.

The issuance of licenses was placed in the hands of the superintendent of the fish-cultural station at Afognak until July 10, when William E. Baumann was put in charge of patrol work about the island. He took over the licensing of fishermen for the remainder of the season.

Fishing began May 11 and continued until September 9. Salmon were taken at seven localities, the total catch being 125,538, all species except kings being taken. This catch was sold to the Kodiak Fisheries Co., at Kodiak.

The following table shows the total take of salmon for commercial uses in the Afognak Reservation:

COMMERCIAL CATCH OF SALMON IN WATERS OF AFOGNAK RESERVATION IN 1920.

Locality.	Coho.	Chum.	Humpback.	Red.	Total.
Little Afognak.....	5, 128		34, 374	8, 556	48, 058
Danger Bay.....	840				840
Litnik Bay.....	6, 194			7	6, 201
Paramanoff Bay.....		35	15, 385	18, 009	33, 429
Seal Bay.....			190	11, 733	11, 923
Malina Bay.....			10, 995	10, 728	21, 723
Izhut Bay.....				3, 364	3, 364
Total.....	12, 162	35	60, 944	52, 397	125, 538

As compared with the catch in 1919, cohos increased approximately 16.7 per cent, humpbacks increased 164.2 per cent, and reds declined 50.9 per cent. Chum salmon were taken in negligible quantities, while no kings were obtained.

ALEUTIAN ISLANDS RESERVATION.

The report in regard to permits for fishery operations in the Aleutian Islands Reservation in 1919 stated that at the end of the calendar year 1919 there were 20 permits remaining in effect. Permit No. 18, granted June 22, 1917, to Andrew C. Smith for salmon and cod operations at Unalaska Island, was canceled late in the year. During 1920 the following permits were canceled: No. 21, granted September 19, 1917, to Paul Buckley for whaling operations; No. 35, granted November 6, 1918, to Samuel Applegate for commercial fishery operations at Umnak Island; and No. 41, granted September 6, 1919, to Lars Mikkelsen for cod operations on Unalaska, Akun, and Tigalda Islands. These four permits were canceled upon request of the holders for reissuance in other names. Four additional permits were granted during 1920, which with the 16 remaining in effect made a total of 20 outstanding at the end of the calendar year 1920.

PERMITS FOR FISHERY OPERATIONS IN ALEUTIAN ISLANDS RESERVATION GRANTED DURING CALENDAR YEAR 1920.

No.	Date.	Grantee.	Location and scope of operations.
42	Apr. 9	American Whale Products Co.	Whaling plant. Udagak Bay, Unalaska Islands.
43	Sept. 16	American Fishing & Packing Co.	Blorki, Rootok, Avatanak, Ugamak, Unalga, and Unalaska Islands. Cod stations.
44	Oct. 11	A. C. Goss.....	Umnak Island. Commercial fishery operations; erection of salmon cannery prohibited.
45	Oct. 23	Bering Sea Fisheries Co..	Six locations on Unalaska Island, Akun Island, and Tigalda Island. Cod stations.

Two permits were granted jointly by the Departments of Agriculture and Commerce in connection with certain stock-raising and mining activities within the reservation. Four grazing permits previously granted remained effective.

JOINT PERMITS IN ALEUTIAN ISLANDS RESERVATION GRANTED IN CALENDAR YEAR 1920.

Date.	Grantee.	Purpose and location.
Jan. 14	L. A. Lavigne.....	To raise sheep and cattle on Unalga Island.
Oct. 29	Alaska Sulphur Co.....	For construction of an aerial tramway for mining operations on Akun Island.

ANNETTE ISLAND FISHERY RESERVE.

By presidential proclamation of April 28, 1916, Annette Island and neighboring small islands were made a fishery reserve for the exclusive benefit of the Metlakatla Indians then living thereon, and

for such other Indians of Alaska as might desire to establish their homes in the reservation. The Bureau of Education, Department of the Interior, administers the affairs of the reserve for the Indians residing therein.

In 1918 fishing privileges in the reserve were leased to the Annette Island Packing Co. under a five-year contract, which provided that the company should pay to the Metlakatlans a royalty of 1 cent per fish for all salmon taken by traps in the coastal waters of Annette Island and a fee of \$100 for each trap operated, and that all labor in connection with the catching and canning of salmon, except that of a few skilled mechanics, should be performed by the Indians. The company was also to employ the Indians at all common labor required in the maintenance and upkeep of the cannery. The season of 1920 was the third year of operations by the company in accordance with the terms of the contract.

Seven traps were operated by the company, for which a fee of \$700 was paid. The catch of salmon by traps was 967,600, for which the Indians received \$9,676; contract labor in the cannery brought them a return of \$36,298.88, while payments for 75,268 salmon taken by purse seines and for labor on buildings and docks, including material, such as lumber and piling, further increased the income of the Metlakatlans by \$24,391.86. The total disbursement of money to the Indians by the Annette Island Packing Co. was \$71,066.74, or \$18,966.14 less than in 1919.

COPPER RIVER FISHERY.

The importance and peculiar geographical conditions of the Copper River fishery again warrant special mention. In 1920 this fishery produced 946,452 salmon of all species as compared with a catch of 1,307,401 in 1919 and of 869,350 in 1916, the year in which the progenitors of the 1920 run made their appearance.

In all, nine packing companies took salmon from the Copper River in 1920, eight of which carried on fishing in the delta district, while one operated exclusively in the lake and canyon sections. Those operating on the delta were the Canoe Pass Packing Co., Carlisle Packing Co., Eyak River Packing Co., Alaska Sea Food Co., Hoonah Packing Co., Pioneer Packing Co., Hillery-Scott Co., and Hayes-Graham Fish Co. The only operator in the up-river district was F. H. Madden, who packed at the cannery formerly listed under the name of the Abercrombie Packing Co. It is of interest also to record that the Hayes-Graham Fish Co. operated a floating cannery on the delta at the entrance to Pete Dahl Slough.

There were 46,000 fathoms of gill nets used in the delta fishery and 4,227 fathoms in Miles Lake, a total of 50,427 fathoms for the river as a whole. This is a decrease in nets at the delta of 18,800 fathoms, or approximately 28.8 per cent, and an increase at the lake of 977 fathoms of nets, or approximately 30 per cent. Practically no change in the number of dip nets was noted between 1919 and 1920.

The following table shows the catch of salmon by districts and species during the five years from 1916 to 1920, inclusive:

CATCH OF SALMON IN COPPER RIVER FROM 1916 TO 1920, INCLUSIVE.

District and species.	1916	1917	1918	1919	1920
Delta district:					
Cohos.....	79,396	55,564	36,247	24,872	55,484
Kings.....	5,440	5,134	4,292	8,972	15,066
Reds.....	300,157	455,001	745,522	1,066,090	700,342
Humpbacks.....	31,578				
Total.....	416,571	515,699	786,061	1,129,934	770,912
Lake and Canyon district:					
Cohos.....	36,034	36,839	25,509	15,778	18,440
Kings.....	8,765	8,050	14,806	4,092	6,345
Reds.....	407,980	309,324	484,607	157,597	150,755
Total.....	452,779	354,213	524,922	177,467	175,540
Grand total.....	869,350	869,912	1,310,983	1,307,401	946,452

On October 5, 1920, a preliminary hearing was held at Cordova, Alaska, to consider the advisability of amending the order of December 20, 1918, limiting or prohibiting fishing in the Copper River, and a further hearing on the same matter was held at Seattle, Wash., on November 18, 1920. As a result of these hearings the order of December 20, 1918, was continued in force until September 1, 1921, on and after which date all commercial fishing in the Copper River, its lakes and tributaries, and within 500 yards of the mouth of its outlets is prohibited. The closing order is given in full on page 11 of this report.

YUKON RIVER FISHERY.

The Carlisle Packing Co. carried on practically all the commercial fishing for salmon for export from the Yukon River in 1920. The cannery was located at Kwiguk Slough, and operations were restricted to the south mouth of the river below the junction of the Clear River, and to the waters of Bering Sea more than 500 yards off the mouth of the Yukon.

The total catch of salmon by this company was 214,122, of which 155,655 were chums and 58,467 were kings. Of these, 105,218 chums and 40,493 kings, or approximately 68 per cent, were taken in outside waters beyond the jurisdiction of the Department. The catch in the river was 50,437 chums and 17,974 kings. The pack consisted of 12,876 cases of chums, 15,961 cases of kings, and 145 tierces and 20 barrels of mild-cured and pickled king salmon. These operations gave employment to 176 whites, 53 natives, and 41 Japanese, or a total of 270 persons. The investment was \$534,000; the value of all products was \$349,356. Fishing apparatus consisted of 2 fish wheels and 12,000 fathoms of gill nets.

During the summer of 1920 the Yukon River was visited by Dr. Charles H. Gilbert, of Stanford University, and Henry O'Malley, field assistant of the Bureau, who made an examination of the river from Dawson, Yukon Territory, to the delta. They collected much information and data regarding the runs of salmon and the number of fish used by the residents of the Yukon Valley. They were accompanied by Inspector Calvin F. Townsend, who gave particular attention to the enforcement of the fishery laws and regulations in that region from the middle of June to the end of July. The Bureau's

boats *Swan* and *Tern* were used in cruising the Yukon and some tributaries. The report by Dr. Gilbert and Mr. O'Malley is published in full elsewhere in this document.

In line with the recommendation in their report that all commercial fishing in the Yukon be suspended, a public hearing was held in Seattle, Wash., on November 23, 1920, to consider the advisability of such action. Satisfactory information was presented at that hearing in support of the opinion generally expressed that commercial fishing for export could not be continued without seriously depleting the runs of salmon and jeopardizing the lives of the native inhabitants of the region and their indispensable dogs. Accordingly the Secretary of Commerce issued an order on December 18, 1920, prohibiting the taking of salmon for other than local use from the Yukon River, its tributaries, and the waters within 500 yards of the mouth thereof after August 31, 1921.

HATCHERIES.

EXTENT OF OPERATIONS.

The two Federal salmon hatcheries in Alaska, one on McDonald Lake, in the southeast district, and the other on Afognak Lake, in the central district, were operated in 1920, except that at the station first named no eggs were collected during the year. In addition, two private hatcheries were operated in southeast Alaska, one a few miles from Loring, owned by the Alaska Packers Association, and the other at Quadra, owned by the Northwestern Fisheries Co. All of these hatcheries were engaged chiefly in the propagation of red salmon.

The Territorial Fish Commission of Alaska also operated a hatchery at Juneau, the collection of eggs being made at two field stations, one of which was on the mainland of Alaska, a few miles north of Juneau, while the other was at Auk Cove, on the north shore of Admiralty Island, about 25 miles southwest of Juneau.

Exclusive of the number collected by the Territorial commission, the total take of red-salmon eggs by the Federal and privately owned hatcheries hereinbefore mentioned was 99,990,000, or 19,070,000 less than the number collected in 1919. This smaller collection is accounted for by the total suspension of operations at the McDonald Lake station, where important repairs to the plant were being made, and also by the washout of retaining racks at the Afognak station during the spawning season.

OPERATIONS OF FEDERAL AND PRIVATE HATCHERIES IN ALASKA IN 1920.

Station.	Red or sockeye salmon eggs taken in 1919.	Red or sockeye salmon liberated in 1919-20.	Red or sockeye salmon eggs taken in 1920.
McDonald Lake.....	9,752,000	9,387,000	.....
Afognak Lake.....	179,178,000	61,524,000	62,300,000
Fortmann.....	18,420,000	17,070,000	18,240,000
Quadra.....	11,710,000	11,357,000	19,450,000
Total.....	119,060,000	99,338,000	99,990,000

17,000,000 eyed eggs transferred to the Federal hatchery at Quinalt, Wash., and 3,000,000 to the State hatchery at Bonneville, Oreg.

HATCHERY REBATES.

Under the law of 1906 for the protection and regulation of the fisheries of Alaska, the owners of privately operated hatcheries in Alaska are exempt from the payment of all taxes and license fees on their catch and pack of salmon at the rate of 40 cents per 1,000 red or king salmon fry liberated, which is equivalent to the tax of 4 cents per case on 10 cases of canned salmon. This rebate is obtained by the operators filing with the clerk of the district court of the judicial division of Alaska in which the hatchery is located an affidavit showing the number of red and king salmon fry planted in the waters of Alaska in the year covered by the affidavit. The clerk of the court then issues certificates to the owners of the hatcheries for the number of fry liberated, and these in turn are accepted by the Government in payment of taxes and licenses as aforesaid.

Rebates due private hatchery operators are shown in the following table:

REBATES CREDITED TO PRIVATE SALMON HATCHERIES DURING FISCAL YEAR ENDED
JUNE 30, 1920.

Owner.	Location.	Red-salmon fry liber- ated.	Rebate due.
Alaska Packers Association.....	Naha Stream.....	17,070,000	\$6,828.00
Northwestern Fisheries Co.....	Hugh Smith Lake.....	11,357,000	4,542.80
Total.....		28,427,000	11,370.80

HATCHERY OPERATIONS.

M'DONALD LAKE.

In 1919 a collection of 9,752,000 red-salmon eggs was made at the McDonald Lake station, from which 9,387,000 fry were hatched and planted in contiguous waters. There was a loss of 365,000 eggs and fry, or approximately 3.8 per cent.

No eggs were collected at that station in 1920, owing to the fact that the water-supply pipe line had to be renewed, an entire complement of new hatching troughs provided, and a new foundation put under the hatchery building. As this work could be done satisfactorily only in the summer months, it was necessary to suspend fish-cultural work for the season.

AFOGNAK.

Out of the 79,178,000 red-salmon eggs taken at the Afognak station in 1919, a shipment of 7,000,000 eyed eggs was made to the Bureau's station at Quinault, Wash., and another of 3,000,000 to the Oregon State hatchery at Bonneville. From the eggs remaining there were hatched and liberated in Afognak Lake 61,524,000 fry. The loss was 7,654,000 eggs and fry, or approximately 9.6 per cent.

In 1920 a total of 62,300,000 red-salmon eggs was collected by September 24. Spawn taking was stopped at that time by high water, which damaged the retaining racks and allowed the escape of all un-

spawned salmon, thus materially affecting the possible take of eggs. The run of salmon was reported as being equal to that of 1919, or sufficient to have yielded a quantity of eggs far in excess of the capacity of the hatchery.

FORTMANN.

The Alaska Packers Association operated the hatchery at Heckman Lake, on Revillagigedo Island, as heretofore. In 1919 a collection of 18,420,000 red-salmon eggs was made, from which 17,070,000 fry were hatched and planted in the Naha stream system. The loss during incubation was 1,350,000, or approximately 7.3 per cent.

Egg collecting in 1920 began September 4 and ended November 11. In that time 18,240,000 red-salmon eggs were obtained. In addition 360,000 humpback-salmon eggs were also taken.

QUADRA.

The Quadra hatchery on Hugh Smith Lake is owned by the Northwestern Fisheries Co. Out of the 11,710,000 red-salmon eggs taken in 1919, there were hatched and liberated 11,357,000 fry, the loss being 353,000, or 3 per cent.

Egg taking in 1920 began August 5 and ended October 28, resulting in a collection of 19,450,000, an increase of more than 71 per cent over 1919.

JUNEAU.

The Alaska Territorial Fish Commission operates a hatchery in a rented building at Juneau. The plant appears to be modern and is equipped with concrete troughs. No ponds, however, are available for rearing purposes. The commission began this work in 1919, and in 1920 the capacity of the hatchery was enlarged to handle 10,000,000 salmon eggs.

In 1919 the commission reported the collection of salmon eggs as follows: Cohos, 10,540,000; chums, 3,425,000; and humpback, 890,000—a total of 14,855,000. Of the resulting product, 6,815,000 were distributed as eyed eggs and 5,250,000 as fertilized eggs, while 2,110,000 were distributed as fry. The loss in eyeing and hatching was 680,000. The distributions occurred in waters on Admiralty and Baranof Islands and streams on the mainland in the Juneau region.

In 1920 the commission reported a collection of 17,020,000 salmon eggs, of which 6,460,000 were cohos, 5,250,000 chums, 4,640,000 humpbacks, and 670,000 reds. Of these, irrespective of species, 4,885,000 were planted as eyed eggs, 6,500,000 as fertilized eggs, and 2,919,000 were distributed as fry. The loss of eggs held through the period of incubation was 846,000, or a little more than 8 per cent. By species, these distributions were cohos, 5,730,000; chums, 5,000,000; humpbacks, 3,410,000; and reds, 134,000. The fry remaining in the hatchery totaled 1,900,000.

GENERAL STATISTICS OF THE FISHERIES IN 1920.

The total investment in the fisheries of Alaska in 1920 was \$70,986,221, or \$3,195,339 less than in 1919. Approximately 89 per cent

of this amount was invested in the salmon industry. Employment was given to 27,482 persons or 1,052 less than in 1919. The total value of the products in 1920 was \$41,492,124, a decrease of \$8,789,940, or approximately 17½ per cent. The important factor in this reduced production was the smaller pack of salmon in southeast Alaska.

SUMMARY OF INVESTMENTS IN THE FISHERIES OF ALASKA IN 1920.

Industries.	Southeast Alaska.	Central Alaska.	Western Alaska.	Total.
Salmon canning.....	\$30,153,798	\$14,058,952	\$18,337,977	\$62,550,727
Salmon mild-curing.....	213,632	.....	.....	213,632
Salmon pickling.....	9,800	560	288,321	298,681
Salmon dry salting.....	.....	.....	45,232	45,232
Salmon by-products.....	375,127	.....	.....	375,127
Halibut fishery.....	2,270,722	.....	.....	2,270,722
Herring fishery.....	443,346	949,006	4,260	1,396,612
Cod fishery.....	.....	1,639,453	418,275	2,057,728
Whale fishery.....	\$635,709	88,904	1,076,297	1,700,910
Crab fishery.....	550	200	.....	750
Shrimp fishery.....	76,100	.....	.....	76,100
Total.....	34,078,784	16,737,075	20,170,362	70,986,221

SUMMARY OF PERSONS ENGAGED IN THE FISHERIES OF ALASKA IN 1920.

Races.	Southeast Alaska.	Central Alaska.	Western Alaska.	Total.
Whites.....	6,629	3,648	5,775	16,052
Natives.....	2,442	874	417	3,733
Chinese.....	1,115	563	691	2,369
Japanese.....	1,071	273	101	1,445
Filipinos.....	862	358	367	1,587
Mexicans.....	278	174	1,227	1,679
Negroes.....	24	53	230	307
Miscellaneous.....	184	19	107	310
Total.....	12,605	5,962	8,915	27,482

SUMMARY OF PRODUCTS OF THE ALASKAN FISHERIES IN 1920.

Products.	Quantity.	Value.
Salmon:		
Canned.....cases..	4,429,463	\$35,602,800
Mild-cured.....pounds..	1,857,800	364,219
Pickled.....do..	964,400	104,873
Frozen.....do..	1,916,595	161,143
Fresh.....do..	3,248,081	263,264
Dry salted.....do..	224,840	37,535
Dried and smoked.....do..	20,000	3,250
By-products, oil.....gallons..	39,052	16,370
By-products, fertilizer.....pounds..	1,778,000	88,382
Halibut:		
Fresh.....do..	7,506,763	1,034,380
Frozen.....do..	7,788,017	692,343
Canned.....do..	720	75
Herring:		
Canned, 1-pound cans.....cases..	3,602	28,980
Fresh for food.....pounds..	2,400	105
Fresh for bait.....do..	1,559,100	21,167
Frozen for bait.....do..	2,525,700	20,027
Pickled, Scotch cure.....do..	8,223,490	490,485
Pickled, spiced.....do..	8,000	400
Pickled, Norwegian cure.....do..	344,619	22,199
Fertilizer.....do..	6,078,000	316,161
Oil.....gallons..	681,067	404,090

SUMMARY OF PRODUCTS OF THE ALASKAN FISHERIES IN 1920—Continued.

Products.	Quantity.	Value.
Cod:		
Dry salted.....pounds..	10,837,321	\$932,110
Pickled.....do.....	1,895,638	181,647
Fresh.....do.....	565	23
Stockfish.....do.....	12,775	2,300
Tongues.....do.....	17,600	1,384
Whales:		
Oil.....gallons..	765,309	304,256
Sperm oil.....do.....	343,611	131,783
Fertilizer, meat.....pounds..	2,436,000	101,105
Fertilizer, bone.....do.....	754,000	15,815
Bone.....do.....	17,484	6,118
Ivory.....do.....	750	225
Clams.....cases..	6,833	46,812
Trout:		
Canned.....do.....	470	2,384
Fresh and frozen.....pounds..	74,476	11,128
Pickled.....do.....	2,000	150
Sablefish.....do.....	584,251	28,584
Crabs:		
Canned.....cases..	70	1,050
Fresh.....pounds..	6,350	690
Shrimps.....do.....	112,045	49,123
Miscellaneous fresh fish.....do.....	11,073	229
Total.....		141,492,124

¹ These figures represent the value of the manufactured product. It is estimated that the value of the catch to the fishermen is approximately \$12,000,000.

SALMON INDUSTRY.

The most prominent features of the salmon industry growing out of the operations of 1920 are (1) the continued falling off in the catch of salmon in southeast Alaska and (2) the increase in production in both central and western Alaska. But the catch of salmon in any district may not be a sufficient indicator of the condition of the fisheries therein unless considered in connection with the character of fishing activities, the amount of gear used, length of season, and the intensiveness of operations. Nor can an accurate analysis of the condition of the fisheries be made until the position and influence of these factors are determined; and even then there are other factors of less prominence which may have an important bearing on the question, as, for instance, the application of restrictive measures designed to afford more protection to the runs of salmon.

Consideration of certain pack figures in the southeastern district for a number of years back may be of interest. From 1912 to and including 1920 the pack of canned salmon in southeast Alaska did not vary markedly, except from 1916 to 1917 and from 1919 to 1920. The first of these movements was upward, with an increase of more than 1,000,000 cases in 1917; the second marked change occurred in 1920, when there was a decrease of almost 900,000 cases from the previous year. In the three seasons of 1917, 1918, and 1919 the production of salmon in southeast Alaska reached its peak. In 1920 the production may be considered as normal, upon the basis of the general average pack for a series of years, and was not exceeded in the period from 1910 to 1916, inclusive, except in 1915.

In central Alaska there was an increase in the pack of all species of salmon except chums, and the total catch of salmon in that dis-

tract in 1920 has been exceeded but once, and then in 1918, when the necessities of war seemed to demand the largest possible output.

Results in the Bristol Bay district of western Alaska show an improvement over 1919. To a large extent the increased pack was due to a much larger run of salmon in the Port Moller region than for several years. The pack in other parts of western Alaska, particularly the Yukon and Kuskokwim Rivers, was less than in 1919.

SALMON CATCH AND FORMS OF GEAR.

Approximately 99 per cent of the commercial catch of salmon in Alaska in 1920 was made by seines, gill nets, and pound nets, while less than 1 per cent was taken with dip nets, lines, and wheels. Records show that 712 seines were used in 1920, the total length of which was 117,111 fathoms. This is 88 less than the number operated in 1919, and a decrease of 20,173 fathoms in the total length of seines. Of the number used, southeast Alaska was credited with 510, central Alaska with 189, and western Alaska with 13. There were 88,013 fathoms of seine webbing used in southeast Alaska, and the average length of each seine was 172 fathoms; in central Alaska 25,698 fathoms were used, the average per seine being 136 fathoms; in western Alaska 3,400 fathoms were operated, with an average of 261 fathoms per seine.

Statistics show that 4,597 gill nets, having a total length of 475,214 fathoms, were used in the salmon fisheries of Alaska in 1920. Of this number, 351 nets, or 41,780 fathoms of webbing, were used in southeast Alaska; 1,469 nets, or 89,217 fathoms, were used in central Alaska; and 2,777 nets, or 344,217 fathoms, were operated in western Alaska. This is an increase of 477 gill nets, or 15,277 fathoms, over the number used in 1919, when 4,120 nets, or 459,937 fathoms of webbing, were operated.

Statistics also show that 653 pound nets were operated in the salmon industry in 1920, as compared with 630 in 1919. There were 445 driven traps, a decrease of 39, and 208 floating traps, an increase of 62. Southeast Alaska leads with 287 driven traps, 14 less than in 1919, and 197 floating traps, an increase of 54 over the number used in the preceding season; central Alaska had 150 driven and 11 floating traps, which was, respectively, 22 less and 8 more than the number used in 1919; western Alaska had 8 driven traps, or 3 less than in 1919. The rapidly increasing use of floating traps in southeast and central Alaska and the decreasing use of pile traps in all districts are noteworthy developments of the year.

Considering Alaska as a whole, the number of fathoms of seines used in 1920 was approximately 15 per cent less than in 1919; there was an increase of 3 per cent in the number of fathoms of gill nets and $3\frac{1}{2}$ per cent increase in the number of pound nets operated in 1920 over that of 1919.

Of the total catch of salmon in 1920, seines took $26\frac{3}{4}$ per cent, gill nets approximately 20 per cent, and pound nets approximately 53 per cent. In 1919 the catch by apparatus was: Seines 36 per cent, gill nets 19 per cent, and pound nets 42 per cent. The change in 1920 was a decrease in catch by seines of $9\frac{1}{4}$ per cent and an increase by gill nets of 1 per cent and by pound nets of 11 per cent. The following

table shows the proportionate catch by districts according to the principal kinds of apparatus:

PERCENTAGE OF SALMON CAUGHT IN EACH ALASKA DISTRICT, BY PRINCIPAL FORMS OF APPARATUS.

Apparatus.	Southeast Alaska.		Central Alaska.		Western Alaska.	
	1919	1920	1919	1920	1919	1920
	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
Seines.....	46	30	31	34	3	6
Pound nets.....	49	66	50	59	4	8
Gill nets.....	2	2	18	7	92	86

In 1920 the production of salmon in Alaska was 65,080,539 as compared with 58,172,665 in 1919, an increase of approximately 12 per cent. The decrease in southeastern Alaska was 6,446,220, or a little more than 16 per cent. In central Alaska there was an increase of 9,836,712, or approximately 101 per cent; in the western district the increase was 3,517,382, or approximately 40 per cent. The striking development of the season was the large catch of salmon in central Alaska, it being next to the largest ever recorded for that district, the catch of 1918 alone exceeding it. Considering Alaska as a whole, the 1920 catch shows that in comparison with that of 1919, cohos decreased 538,987, chums decreased 2,065,483, humpbacks increased 6,217,635, kings decreased 192,525, and reds increased 3,487,194.

SALMON TAKEN IN 1920, BY APPARATUS AND SPECIES, FOR EACH GEOGRAPHIC SECTION OF ALASKA.

Apparatus and species.	Southeast Alaska.	Central Alaska.	Western Alaska.	Total.
Seines:				
Coho, or silver.....	284, 106	85, 014	2, 790	371, 910
Chum, or keta.....	4, 264, 032	308, 537	3, 622	4, 576, 191
Humpback, or pink.....	4, 618, 516	4, 362, 069		8, 980, 585
King, or spring.....	6, 540	2, 187	8, 257	16, 984
Red, or sockeye.....	795, 631	1, 864, 565	761, 682	3, 421, 878
Total.....	9, 968, 825	6, 622, 372	776, 351	17, 367, 548
Gill nets:				
Coho, or silver.....	163, 521	130, 211	160, 125	453, 857
Chum, or keta.....	60, 243	6, 002	581, 470	647, 715
Humpback, or pink.....	73, 898	74, 940	937, 335	1, 086, 173
King, or spring.....	60, 296	22, 320	189, 252	271, 867
Red, or sockeye.....	392, 882	1, 113, 349	8, 787, 947	10, 294, 178
Total.....	750, 839	1, 346, 822	10, 656, 129	12, 753, 790
Pound nets:				
Coho, or silver.....	552, 972	445, 828	6, 380	1, 005, 180
Chum, or keta.....	3, 684, 559	1, 163, 062	42, 110	4, 889, 731
Humpback, or pink.....	16, 232, 881	5, 546, 058	266, 914	22, 045, 853
King, or spring.....	54, 080	48, 550	11, 816	114, 446
Red, or sockeye.....	1, 441, 224	4, 208, 363	649, 867	6, 359, 454
Total.....	21, 965, 716	11, 471, 861	977, 087	34, 414, 664
Lines:				
Coho, or silver.....	44, 710			44, 710
King, or spring.....	366, 510			366, 510
Total.....	411, 220			411, 220

SALMON TAKEN IN 1920, BY APPARATUS AND SPECIES, FOR EACH GEOGRAPHIC SECTION OF ALASKA—Continued.

Apparatus and species.	Southeast Alaska.	Central Alaska.	Western Alaska.	Total.
Dip nets:				
Coho, or silver.....		15,202		15,202
King, or spring.....		5,660		5,660
Red, or sockeye.....		112,415		112,415
Total.....		133,277		133,277
Wheels: Chum, or keta.....	40			40
Total:				
Coho, or silver.....	1,045,309	676,255	169,205	1,890,869
Chum, or keta.....	8,008,874	1,477,601	627,202	10,113,677
Humpback, or pink.....	20,925,295	9,983,067	1,204,249	32,112,611
King, or spring.....	487,425	78,717	209,325	775,467
Red, or sockeye.....	2,629,737	7,358,692	10,199,496	20,187,925
Grand total.....	33,096,640	19,574,332	12,409,567	65,080,539

SALMON CANNING.

CHANGES IN CANNERIES.

Three changes occurred in the ownership of canneries in Alaska in 1920. The plant of the Tee Harbor Packing Co., at Tee Harbor, was purchased by the Alaska Pacific Fisheries; the Pavlof Harbor Packing Co. acquired the cannery of the Alaska Packing & Navigation Co. at Pavlof Harbor; the Tenakee Fisheries Co. transferred its plant at Tenakee to the Standard Salmon Packers (Inc.); and the Sockeye Salmon Co. leased its cannery on Isanotski Strait to P. E. Harris & Co. The Everett Packing Co. operated its cannery at Herendeen Bay in the interest of the Herendeen Bay Consolidated Canneries. The Thlinket Packing Co. changed its name to the Thlinket Packing Corporation.

NEW CANNERIES.¹

There were 16 new salmon canneries in Alaska in 1920, 8 of which were opened and operated in southeast Alaska.

In the central district seven new canneries were operated in 1920.

In western Alaska one new cannery, which had been constructed by the Alaska Packers Association in 1919, was put in operation in 1920.

In addition to these plants Robert J. Peratovich put up a small pack by hand at Bayview, Prince of Wales Island, and W. J. O'Connor packed a few cases on the Yukon River delta.

CANNERIES NOT OPERATED.

There were 10 idle canneries in Alaska in 1920, of which 5 were in southeast Alaska, 2 in central, and 3 in western Alaska. The cannery of the Fidalgo Island Packing Co., at Herendeen Bay, was

¹ New canneries are indicated by an asterisk (*) in the table on page 50.

dismantled and will not be operated again. The inactive plants were owned and located as follows:

Alaska Fish Co.....	Waterfall.
Cape Fanshaw Fish & Packing Co. (Inc.).....	Cape Fanshaw.
Columbia Salmon Co.....	Craig.
Southern Alaska Canning Co.....	Quadra Bay.
Northwestern Fisheries Co.....	{ Hunter Bay.
	{ Orca.
	{ Seldovia.
Nelson Lagoon Packing Co.....	Nelson Lagoon.
Phoenix Packing Co.....	Herendeen Bay.
Midnight Sun Packing Co.....	Kotzebue Sound.

TOTAL CANNERIES OPERATED.

There were 146 salmon canneries operated in Alaska in 1920, as compared with 134 in 1919, of which 82 were located in southeast Alaska, 36 in central Alaska, and 28 in western Alaska. This is an increase of six in both the southeastern and central districts, while the number in western Alaska remains unchanged.

COMPANIES CANNING SALMON IN ALASKA, NUMBER AND LOCATION OF CANNERIES OPERATED, AND NUMBER OF POUND NETS OWNED BY EACH, 1920.

[New canneries indicated by (*).]

Company.	Canneries.		Pound nets.
	Num- ber.	Location.	
Southeast Alaska:			
Ainsworth-Dunn Co.....	1	Floating *.....	1 20
Alaska Herring & Sardine Co.....	1	Port Walter.....	1 20
Alaska Pacific Fisheries.....	3	Chomley.....	1 16
		Tee Harbor.....	1 13
		Yes Bay.....	1 11
		Loring.....	1 8
Alaska Packers Association.....	2	Wrangell.....	1 8
Alaska Salmon & Herring Packers.....	1	Tyee.....	1 8
Alaska Sanitary Packing Co.....	2	Cape Fanshaw.....	1 8
		Wrangell.....	1 8
Alaska Union Fisheries (Inc.).....	1	Port Conclusion *.....	1 8
American Packing Co.....	1	Juneau.....	1 7
Anacortes Fisheries Co.....	2	Kasaan.....	1 7
		Shakan.....	1 7
Annette Island Packing Co.....	1	Metlakatla.....	1 7
Astoria & Puget Sound Canning Co.....	1	Excursion Inlet.....	1 12
Auk Bay Salmon Canning Co.....	1	Auk Bay.....	1 6
Baranof Packing Co.....	1	Red Bluff Bay.....	1 6
F. C. Barnes Co.....	1	Lake Bay.....	1 6
Beauchaire Packing Co.....	1	Port Bonaville.....	1 6
Beagle Packing Co.....	1	Ketchikan.....	1 5
Burnett Inlet Packing Co.....	1	Burnett Inlet.....	1 5
Cape Flattery Fisheries Co.....	1	Floating *.....	1 5
John L. Carlson & Co.....	1	Auk Bay.....	1 5
Chilkat Packing Co.....	1	Haines *.....	1 5
Columbia Salmon Co.....	1	Tenakee Inlet.....	1 5
Deep Sea Salmon Co.....	2	Ford Arm.....	1 5
		Port Althorp.....	1 25
Douglas Island Packing Co.....	1	Douglas.....	1 5
Fidalgo Island Packing Co.....	2	Ketchikan.....	1 12
		Pillar Bay.....	1 12
George Inlet Packing Co.....	1	George Inlet.....	1 2
Haines Packing Co.....	1	Letinkof Cove.....	1 2
P. E. Harris & Co.....	1	Hawk Inlet.....	10 15
Hidden Inlet Canning Co.....	2	Hidden Inlet.....	1 5
		Hood Bay.....	1 5
Hood Bay Packing Co.....	1	Hood Bay.....	1 5

¹ Seventeen floating.

² Four floating.

³ Three floating

⁴ Eight floating.

⁵ Six floating.

⁶ Seven floating.

⁷ One floating.

⁸ Two floating.

⁹ All floating.

¹⁰ Nine floating.

COMPANIES CANNING SALMON IN ALASKA, NUMBER AND LOCATION OF CANNERIES OPERATED, AND NUMBER OF POUND NETS OWNED BY EACH, 1920—Continued.

Company.	Canneries.		Pound nets.
	Num- ber.	Location.	
Southeast Alaska—Continued.			
Hoonah Packing Co.....	2	Gambler Bay.....	15
G. W. Hume Co.....	2	Hoonah.....	13
Karheen Packing Co.....	1	Nakat Harbor.....	6
Ketchikan Packing Co.....	1	Seow Bay.....	3
Libby, McNeill & Libby.....	2	Karheen.....	5
Marathon Fishing & Packing Co.....	1	Ketchikan.....	2
Mount Baker Packing Co.....	1	Taku Harbor.....	18
Mountain Point Packing Co.....	1	Yakutat.....	
Mutual Packing Co.....	1	Cape Fanshaw.....	3
Geo. T. Myers & Co.....	1	Floating *.....	
Northern Packing Co. (Inc.).....	1	Wrangell Narrows.....	
North Pacific Trading & Packing Co.....	1	Floating *.....	
	1	Chatham.....	10
	1	Juneau.....	
	1	Klawak.....	1
	1	Dundas Bay.....	9
	4	Quadra.....	7
		Roe Point.....	7
	1	Santa Ana.....	
Noyes Island Packing Co.....	1	Steamboat Bay.....	
Olympic Fisheries Co.....	1	Floating.....	
Pacific American Fisheries.....	1	Excursion Inlet.....	13
Pavlof Harbor Packing Co.....	1	Pavlof Harbor.....	
Petersburg Packing Corporation.....	2	Petersburg.....	13
Point Warde Packing Co.....	1	Washington Bay.....	9
Pure Food Fish Co.....	1	Point Warde.....	
Pybus Bay Fish & Packing Co.....	1	Ketchikan.....	15
Pyramid Packing Co.....	1	Pybus Bay.....	
Revilla Packing Co.....	1	Sitka.....	3
Sanborn-Cutting Co.....	1	Ketchikan *.....	
Sitka Packing Co.....	1	Kake.....	14
J. L. Smiley & Co.....	1	Sitka.....	
	1	Ketchikan.....	8
Southern Alaska Canning Co.....	2	Big Port Walter.....	
Standard Salmon Packers (Inc.).....	1	Rose Inlet.....	10
Starr Collinson Packing Co.....	1	Tenakee Inlet.....	15
Straits Packing Co.....	1	Moiwa Sound.....	2
E. R. Strand.....	1	Skowl Arm.....	
Sunny Point Packing Co.....	1	Wrangell Narrows *.....	
Swift Arthur Crosby Co.....	1	Ketchikan.....	8
Thlinket Packing Corporation.....	1	Hegeta Island.....	3
Todd Packing Co.....	1	Funter Bay.....	21
Union Bay Fisheries Co.....	1	Todd.....	5
Ward's Cove Packing Co.....	1	Union Bay.....	5
	1	Ward Cove.....	3
Central Alaska:			
Alaska Packers Association.....	4	Alltak.....	16
		Chignik.....	4
		Kasilof.....	14
		Larsen Bay.....	
Alaska Sea Food Co.....	1	Point Whited.....	4
Alltak Packing Co.....	1	Lazy Bay.....	4
Arctic Packing Co.....	1	English Bay *.....	
Bainbridge Fisheries Co.....	1	Evans Island *.....	1
Canoe Pass Packing Co.....	1	Shepard Point.....	5
Carlisle Packing Co.....	1	Cordova.....	8
Central Alaska Fisheries.....	1	Drier Bay *.....	1
Columbia River Packers' Association.....	1	Chignik.....	4
Copper River Packing Co.....	1	McClure Bay.....	7
Eyak River Packing Co.....	1	Eyak River.....	
Fidalgo Island Packing Co.....	1	Port Graham.....	7
P. E. Harris & Co.....	1	Isanotski Strait.....	3
Hayes-Graham Fish Co.....	1	Floating *.....	
Hillery-Scott Co.....	1	Cordova.....	1
Hoonah Packing Co.....	1	Bering River.....	4
Kadiak Fisheries Co.....	1	Kodiak.....	1
Kenai Packing Co.....	1	Drier Bay.....	2
King Salmon Fisheries Co.....	1	Unakwik Inlet *.....	4
Libby, McNeill & Libby.....	1	Kenai.....	13
F. H. Madden.....	1	Abercrombie.....	
Moore Packing Co.....	1	Orca Inlet.....	3

1 One floating.

2 All floating.

3 Six floating.

7 Two floating.

2 Five floating.

4 Four floating.

5 Three floating.

12 Twelve floating.

COMPANIES CANNING SALMON IN ALASKA, NUMBER AND LOCATION OF CANNERIES OPERATED, AND NUMBER OF POUND NETS OWNED BY EACH, 1920—Continued.

Company.	Canneries.		Pound nets.
	Num- ber.	Location.	
Central Alaska—Continued.			
Northwestern Fisheries Co.....	3	Chignik.....	4
		Kenai.....	14
		Uyak.....	7
Pacific American Fisheries.....	2	Ikatan.....	7
		King Cove.....	9
Pioneer Packing Co.....	1	Cordova.....	7
San Juan Fishing & Packing Co.....	1	Seward.....	2
Shumagin Packing Co.....	1	Squaw Harbor*.....	6
Surf Packing Co.....	1	Chisk Island.....	2
Valdez Packing Co.....	1	Valdez.....	15
Seldovia Canning Co.....	1	Seldovia*.....	3
Western Alaska:			
Alaska Packers Association.....	9	Kvichak River (2).....	1
		Naknek River (3).....	1
		Nushagak River (2).....	1
		Ugaguk River.....	1
		Ugashik River*.....	1
Alaska-Portland Packers' Association.....	2	Naknek.....	2
Alaska Salmon Co.....	1	Nushagak Bay.....	2
Bristol Bay Packing Co.....	1	Wood River.....	1
Carlisle Packing Co.....	1	Kvichak River.....	1
Columbia River Packers' Association.....	1	Kwiguk Slough.....	1
Everett Packing Co.....	1	Nushagak Bay.....	1
		Herendeen Bay.....	1
Libby, McNeill & Libby.....	6	Ektuk.....	1
		Kvichak Bay.....	1
		Libbyville.....	1
		Lockanok.....	1
		Nushagak.....	1
Naknek Packing Co.....	1	Ugaguk River.....	1
Northwestern Fisheries Co.....	2	Naknek River.....	1
Pacific American Fisheries.....	1	Naknek River.....	1
Red Salmon Canning Co.....	2	Port Moller.....	5
		Naknek River.....	1
		Ugashik River.....	1

* One floating.

LOSSES AND DISASTERS IN THE SALMON-CANNING INDUSTRY.

The loss of property by those interested in the salmon industry of Alaska in 1920 was unusually heavy. Four disastrous fires occurred in the southeastern district. The first fire occurred on May 25, before canning had commenced, and it destroyed the cannery of the Mountain Point Packing Co., on Wrangell Narrows, which with the machinery, fishing gear, and floating equipment was valued at \$60,998. The plant was not rebuilt during the season.

The other three fires occurred in August, and entailed considerably heavier losses, being the cause of the destruction of much larger plants at each of which several thousand cases of salmon had been packed and were stored. All of these canneries were located in the southern part of the southeastern district, and were burned in the same month.

The cannery of the Straits Packing Co., at Skowl Arm, including warehouse and equipment, fishing gear in stock, all other stock, and 4,000 cases of canned salmon, was burned on August 6. The total loss was reported as being \$150,000.

On August 20 practically the entire plant of the Hidden Inlet Canning Co. at Hidden Inlet was destroyed by fire, entailing a loss in buildings, supplies, equipment, and canned salmon of \$217,823.

The burning of the Nakat Inlet cannery of the G. W. Hume Co. occurred on August 28. Buildings and fishing gear valued at \$75,000 were lost.

The Chinese quarters at the Roe Point cannery of the Northwestern Fisheries Co. were burned, at a loss of \$4,635.

The vessel losses in southeastern Alaska aggregated \$35,660, chief of which was that of the barge *Dashing Wave*, owned by Libby, McNeill & Libby, and valued at \$15,000.

A rather heavy loss of fishing apparatus was also reported, which in the aggregate was valued at \$80,288. Of this amount, \$67,238 represented the value of traps that were destroyed.

Property losses in central Alaska amounted to \$22,544, the major part of which consisted of fishing apparatus. In western Alaska losses of property having a total value of \$126,966 were reported, of which \$88,802 was charged under vessels and floating equipment, \$31,664 to fishing apparatus, and \$6,500 to buildings and wharves. The notable item in these losses was that of the ship *Chas. E. Moody*, owned by the Northwestern Fisheries Co., and valued at \$80,000.

In 1920 the total loss of property in the salmon industry throughout Alaska was reported as \$773,914, of which approximately 81 per cent was sustained by operators in the southeastern district. The loss of life in this industry was considerably greater than in 1919. In southeastern Alaska 1 fisherman, 3 shoresmen, and 1 transporter met accidental death; in central Alaska 2 shoresmen and 1 transporter were killed and 2 transporters were drowned; in western Alaska 11 fishermen and 2 shoresmen were drowned and 2 shoresmen were killed.

STATISTICS.

There were operated in Alaska in 1920 a total of 146 salmon canneries, 12 more than in 1919. Several of them were small floating plants. The investment in the salmon-canning industry was \$62,550,727, a decrease of \$3,944,444. There was a decline of \$3,588,093 in southeast Alaska and \$1,517,356 in western Alaska. In central Alaska the investment increased \$1,161,005.

The canning industry gave employment to 24,423 persons, or 1,076 less than in 1919. Whites decreased 345, natives 126, Chinese 401, Japanese 39, and Mexicans 214. Filipinos increased 10, and miscellaneous, including Negroes, 39.

The pack of canned salmon was 4,429,463 cases, valued at \$35,602,800, a decrease of 154,225 cases in the pack and of \$7,662,549 in value of the products of 1920 as compared with those of 1919. This is a decline of approximately $3\frac{1}{2}$ per cent in production and $17\frac{3}{4}$ per cent in value from 1919. These decreases in quantity and value of products are directly and entirely due to the smaller pack in southeast Alaska, as in both the other districts the pack was larger than in 1919. A comparison of the pack in 1920 with that in 1919, by districts, shows that southeast Alaska dropped from 3,119,260 cases to 2,225,011, a decrease of 894,249 cases; central Alaska increased from 771,907 to 1,337,448, a gain of 565,541 cases; and western Alaska

increased from 692,521 to 867,004, an advance of 174,483 cases. A further comparison of the pack by species for 1919 and 1920 in Alaska as a whole shows that cohos decreased from 232,870 to 192,085 cases, a decline of 40,785 cases; chums decreased from 1,365,563 to 1,033,517, a drop of 332,046 cases; humpbacks decreased from 1,611,608 to 1,593,120, a drop of 18,488 cases; kings increased from 95,986 to 110,003, a gain of 14,017 cases; and reds advanced from 1,277,661 to 1,500,738, a gain of 223,077 cases.

INVESTMENT IN THE SALMON-CANNING INDUSTRY IN 1920.

Item.	Southeast Alaska.		Central Alaska.		Western Alaska.		Total.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Canneries operated....	82	\$6,914,996	36	\$2,832,902	28	\$4,885,074	146	\$14,632,882
Working capital.....		10,350,339		4,702,152		3,764,804		18,817,296
Wages paid.....		5,635,911		3,337,521		4,507,020		13,540,452
Vessels:								
Power vessels over 5 tons.....	382	2,801,915	110	1,023,750	75	1,939,076	567	5,764,741
Net tonnage.....	7,405		2,613		7,664		17,682	
Sailing.....	2	65,000	7	325,199	32	1,295,300	41	1,685,499
Net tonnage.....	3,004		10,788		47,220		61,012	
Barges.....	1	6,377					1	6,377
Net tonnage.....	1,354						1,354	
Launches, under tonnage.....	131	157,919	171	180,874	42	146,801	344	485,594
Boats, row and sail	1,234	106,135	915	128,720	1,538	651,074	3,687	885,929
Lighters, scows, and houseboats..	430	420,389	270	288,417	197	445,910	897	1,154,716
Pile drivers and pile pullers.....	68	505,491	44	212,715	25	85,905	137	804,111
Apparatus:								
Beach seines.....	107	50,954	115	47,043			222	97,997
Fathoms.....	11,643		14,959				26,602	
Purse seines.....	402	332,824	73	40,543	13	22,700	488	395,067
Fathoms.....	76,295		10,689		3,400		90,384	
Gill nets.....	343	65,492	1,469	140,163	2,616	499,313	4,428	704,968
Fathoms.....	39,455		89,217		332,275		460,947	
Pound nets, driven	285	2,157,806	150	767,083	8	35,000	443	2,959,889
Pound nets, float-								
ing.....	197	582,340	11	28,511			208	610,851
Dip nets.....			184	603			184	603
Lines.....				2,756				2,756
Total.....		30,153,798		14,058,952		18,337,977		62,550,727

PERSONS ENGAGED IN THE SALMON-CANNING INDUSTRY IN 1920.

Occupations and races.	Southeast Alaska.		Central Alaska.		Western Alaska.		Total.	
Fishermen:								
Whites.....	1,832		1,283		2,862		5,977	
Natives.....	1,249		292		75		1,616	
Miscellaneous ¹	74						74	
Total.....	3,155		1,575		2,937		7,667	
Shoresmen:								
Whites.....	2,628		1,156		2,251		6,035	
Natives.....	1,085		539		227		1,851	
Chinese.....	1,115		503		691		2,309	
Japanese.....	1,018		273		101		1,392	
Filipinos.....	802		358		367		1,527	
Mexicans.....	264		174		1,214		1,652	
Negroes.....	24		53		230		307	
Miscellaneous ¹	59		18		106		183	
Total.....	7,055		3,134		5,187		15,376	

¹ Koreans, Porto Ricans, Kanakas, etc.

PERSONS ENGAGED IN THE SALMON-CANNING INDUSTRY IN 1920—Continued.

Occupations and races.	Southeast Alaska.	Central Alaska.	Western Alaska.	Total.
Transporters:				
Whites.....	812	295	204	1,311
Natives.....	17	18	6	41
Miscellaneous ¹	26	1	1	28
Total.....	855	314	211	1,380
Grand total:				
Whites.....	5,272	2,734	5,317	13,323
Natives.....	2,331	849	308	3,506
Chinese.....	1,115	563	691	2,369
Japanese.....	1,018	273	101	1,392
Filipinos.....	862	358	367	1,587
Mexicans.....	264	174	1,214	1,652
Negroes.....	24	53	230	307
Miscellaneous ¹	159	19	107	285
Total.....	11,065	5,023	8,335	24,423

¹ Koreans, Porto Ricans, Kanakas, etc.OUTPUT OF CANNED SALMON IN 1920.¹

Product.	Southeast Alaska.		Central Alaska.		Western Alaska.		Total.	
	Cases.	Value.	Cases.	Value.	Cases.	Value.	Cases.	Value.
Coho, or silver:								
$\frac{1}{2}$ -pound flat.....	7,602	\$91,541	1,267	\$14,733	46	\$55	8,915	\$106,332
1-pound flat.....	8,395	80,295	1,314	14,454	1,037	10,997	10,746	105,746
1-pound tall.....	95,951	831,599	64,660	595,230	11,813	114,463	172,424	1,541,292
Total.....	111,948	1,003,435	67,241	624,417	12,896	126,018	192,085	1,753,870
Chum, or keta:								
$\frac{1}{2}$ -pound flat.....	53	394	.....	.....	.....	.....	53	394
1-pound flat.....	44,582	154,353	1,585	7,291	.....	.....	46,167	161,644
1-pound tall.....	792,480	3,298,390	141,715	620,692	53,102	255,531	987,297	4,174,613
Total.....	837,115	3,453,137	143,300	627,983	53,102	255,531	1,033,517	4,336,651
Humpback, or pink:								
$\frac{1}{2}$ -pound flat.....	18,277	145,749	693	5,900	.....	.....	18,970	151,649
1-pound flat.....	58,265	324,353	17,752	81,659	.....	.....	76,017	406,012
1-pound tall.....	931,095	5,112,406	498,532	2,662,343	68,506	386,640	1,498,133	8,161,389
Total.....	1,007,637	5,582,508	516,977	2,749,902	68,506	386,640	1,593,120	8,719,050
King, or spring:								
$\frac{1}{2}$ -pound flat.....	5,203	85,533	1,922	32,942	3,071	52,812	10,196	171,287
1-pound flat.....	3,611	45,344	1,887	21,677	12,821	194,872	18,319	261,893
1-pound tall.....	37,316	313,532	18,769	158,435	25,403	302,061	81,488	774,048
Total.....	46,130	444,429	22,578	213,054	41,295	549,775	110,003	1,207,228
Red, or sockeye:								
$\frac{1}{2}$ -pound flat.....	46,031	847,564	43,867	773,138	11,818	226,040	101,716	1,846,742
1-pound flat.....	21,378	277,812	51,497	603,054	47,272	630,700	120,147	1,601,556
1-pound tall.....	154,772	1,776,092	491,988	6,280,839	632,115	8,080,772	1,278,875	16,137,703
Total.....	222,181	2,901,458	587,352	7,747,031	691,205	8,937,512	1,500,738	19,586,001
Grand total.....	2,225,011	13,384,967	1,337,448	11,962,387	867,004	10,255,446	4,429,463	35,602,800

¹ Cases containing $\frac{1}{2}$ -pound cans have been reduced one-half in number, and thus, for the purpose of affording fair comparison, all are put upon the basis of 48 1-pound cans per case.

OUTPUT OF CANNED SALMON IN ALASKA, 1914 TO 1920.¹

Product.	1914	1915	1916	1917	1918	1919	1920	Total.
Coho, or silver:	<i>Cases.</i>	<i>Cases.</i>	<i>Cases.</i>	<i>Cases.</i>	<i>Cases.</i>	<i>Cases.</i>	<i>Cases.</i>	<i>Cases.</i>
1-pound flat.....	4,579	2,050	13,145	30,412	26,258	9,719	8,915	95,038
1-pound flat.....	285	2,338	8,191	362	12,786	10,438	10,748	45,146
1-pound tall.....	152,199	119,880	240,573	162,457	179,634	212,713	172,434	1,240,130
Total.....	157,063	124,268	261,909	193,231	218,658	232,870	192,085	1,280,354
Chum, or keta:								
1-pound flat.....	373		1,423	26,760	3,559	3,981	53	36,149
1-pound flat.....	5,568	317		2,530	2,996		46,167	37,578
1-pound tall.....	657,918	479,629	722,022	877,457	1,338,405	1,361,582	987,297	6,444,980
Total.....	663,859	479,946	724,115	906,747	1,364,960	1,365,563	1,033,517	6,508,707
Humpback, or pink:								
1-pound flat.....	2,103	4,325	41,491	91,403	63,557	28,185	18,970	230,034
1-pound flat.....	9,286	3,508	14,796	6,014	20,215	7,553	76,017	137,389
1-pound tall.....	974,699	1,867,683	1,681,506	2,199,559	2,355,182	1,575,870	1,498,133	12,156,393
Total.....	976,049	1,875,516	1,737,793	2,296,976	2,438,954	1,611,608	1,593,120	12,540,006
King, or spring:								
1-pound flat.....	3,143	2,404	2,617	12,973	6,000	7,584	10,196	44,917
1-pound flat.....	4,894	3,755	3,804	5,133	5,267	11,532	18,319	52,614
1-pound tall.....	40,092	82,092	59,452	43,845	37,959	76,870	81,488	421,798
Total.....	48,039	88,251	65,873	61,951	49,226	95,986	110,003	519,329
Red, or sockeye:								
1-pound flat.....	53,825	52,033	81,505	124,309	137,008	122,236	101,716	672,692
1-pound flat.....	64,671	112,847	86,395	89,612	151,864	110,491	120,147	736,027
1-pound tall.....	2,083,147	1,765,139	1,936,971	2,274,460	2,214,865	1,044,934	1,278,875	12,628,391
1½-pound nominal.....		2,293						2,293
2-pound nominal.....			6,006					6,006
Total.....	2,201,643	1,932,312	2,110,937	2,488,381	2,533,737	1,277,661	1,500,738	14,045,499
Grand total.....	4,056,653	4,500,293	4,900,627	5,947,286	6,005,835	4,583,688	4,429,463	35,028,535

¹The number of cases shown has been put upon the common basis of 48 1-pound cans per case.

AVERAGE ANNUAL PRICE PER CASE OF FORTY-EIGHT 1-POUND CANS OF SALMON, 1910 TO 1920.

Product.	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920
Coho, or silver.....	\$4.89	\$5.67	\$4.44	\$3.45	\$4.39	\$4.31	\$5.34	\$8.76	\$9.15	\$11.27	\$9.13
Chum, or keta.....	3.04	3.72	2.37	2.21	3.37	2.59	3.31	6.14	6.27	6.82	4.19
Humpback, or pink.....	3.15	3.94	2.55	2.58	3.50	2.78	3.64	6.44	6.58	8.35	5.47
King, or spring.....	5.34	6.48	5.37	4.04	5.01	4.63	5.36	10.40	9.85	13.13	10.97
Red, or sockeye.....	5.30	6.33	5.45	4.54	5.58	5.82	6.04	9.48	9.44	12.98	13.05

MILD CURING OF SALMON.

The business of mild curing salmon in Alaska fell off materially in 1920, evidence of which is found not only in the smaller pack but also in the withdrawal of six of the largest operators in 1919. Conspicuous among those who withdrew were the Pacific Mild Cure Co., with eight plants, the Columbia & Northern Fishing & Packing Co., Vendsyssel Packing Co., Columbia Salmon Co., and M. B. Dahl & Co. H. R. Thompson, of Ketchikan, was the only important mild curer of last year who continued operations in 1920. The mild curers of 1920 who packed more than 100 tierces each are shown in the following list:

Wrangell Cooperative Association.....	Wrangell.
Atlantic & Pacific Fisheries Co.....	Port Alexander.
Alaska Union Fisheries (Inc.).....	Port Alexander.

H. R. Thompson..... Ketchikan.
 Karl Hansen..... Port Alexander.
 Carlisle Packing Co..... Yukon River.

The total investment in the mild-cure salmon industry was \$213,632. Employment was given to 357 persons. The mild-cure products were 2,295 tierces of king salmon, valued at \$364,219, of which 2,120 tierces were prepared in southeastern Alaska, 26 in central, and 149 in the western district.

INVESTMENT, PERSONS ENGAGED, AND PRODUCTS OF ALASKA SALMON MILD-CURING INDUSTRY IN 1920.

Items.	Tierces.	Number.	Value.
INVESTMENT.			
Plants (all floating).....		4	\$5,600
Operating capital.....			149,677
Vessels:			
Power, over 5 tons.....		7	28,200
Net tonnage.....		86	
Launches under 5 tons.....		4	5,700
Other boats and skiffs.....		12	5,850
Lighters.....		1	1,500
Apparatus:			
Lines.....		657	1,405
Gill nets.....		8	3,700
Fathoms.....		2,325	
Pound nets.....		2	12,000
Total.....			213,632
PERSONS ENGAGED.¹			
Fishermen:			
Whites.....		306	
Natives.....		10	
Total.....		316	
Shoemen: Whites.....		24	
Transporters: Whites.....		13	
Grand total.....		357	
PRODUCTS.			
		<i>Pounds.</i>	
Southeast Alaska: King salmon.....	2,120	1,717,800	341,429
Central Alaska: King salmon.....	26	20,800	5,000
Western Alaska: King salmon.....	149	119,200	17,790
Total.....	2,295	1,857,800	364,219

¹ Southeast Alaska only.

SALMON PICKLING.

The pickling of salmon as a branch of the salmon industry is rapidly losing its importance. Since 1918 there has been a shrinkage in investment of \$1,064,836, or 78 per cent, and in production from 56,890 barrels of salmon to 4,822 barrels, or 91.6 per cent. As compared with the situation in 1919, the investment fell off approximately 50 per cent, or from \$590,422 to \$298,681, and production 41 per cent, from 8,110 barrels valued at \$195,447 to 4,822 barrels valued at \$104,873. From an industry employing 815 men in 1918 and 267 in 1919, it has shrunk until only 157 were employed in 1920, all but 2 of whom were credited to western Alaska. The most noticeable changes occurred in central Alaska. In 1919 that district showed approximately 40 per cent of the capital invested in this industry, whereas in 1920 no salteries were operated and no investment reported. Of the two companies listed in that district a year ago, the

Shumagin Packing Co. changed to the canning business, while the Universal By-Products Co. did not operate. Western Alaska produced 85 per cent of the pack of pickled salmon in 1920, the most conspicuous operators being Libby, McNeill & Libby, Bering Sea Salmon Packing Co., Golden Gate Salmon Co., Peter M. Nelson, and Alaska Salmon Co.

Statistics regarding the salmon-pickling industry in 1920 appear in the following table:

INVESTMENT, PERSONS ENGAGED, AND PRODUCTS OF ALASKA SALMON-PICKLING INDUSTRY IN 1920.

Items.	Southeast Alaska.		Central Alaska.		Western Alaska.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
INVESTMENT.								
Salteries.....	No. 1	\$8,000	No.		No. 6	\$70,547	No. 7	\$78,547
Operating capital.....						106,336		106,336
Vessels:								
Sailing.....					2	50,000	2	50,000
Net tonnage.....					719		719	
Launches.....	1	1,500	1	\$500	11	34,056	13	36,056
Gill net boats.....					33	10,175	33	10,175
Rowboats and skiffs.....					8	615	8	615
Lighters and scows.....					5	3,900	5	3,900
Pile drivers.....					1	250	1	250
Apparatus:								
Haul seines.....	1	300	1	60			2	360
Fathoms.....	75		50				125	
Gill nets.....					161	11,942	161	11,942
Fathoms.....					9,620		9,620	
Wheels.....					2	500	2	500
Total.....		9,800		500		288,321		298,681
PERSONS ENGAGED.								
Fishermen:								
Whites.....			2		60		62	
Natives.....					3		3	
Total.....			2		63		65	
Shoresmen:								
Whites.....					43		43	
Natives.....					26		26	
Mexicans.....					13		13	
Total.....					82		82	
Transporters: Whites.....					10		10	
Grand total.....			2		155		157	
PRODUCTS.¹								
	Barrels.		Barrels.		Barrels.		Barrels.	
Coho, or silver.....	110	2,160	183	3,880	109	2,090	402	8,130
Chum, or keta.....	105	1,400			119	2,360	224	3,760
Humpback, or pink.....	61	882			135	1,400	196	2,282
King, or spring.....	100	2,000	8	160	144	3,201	252	5,361
Red, or sockeye.....	164	3,280	6	150	3,578	81,910	3,748	85,340
Total.....	540	9,722	197	4,190	4,085	90,961	4,822	104,873

¹ Each barrel holds 200 pounds of fish.

SALMON FREEZING.

The freezing of salmon in 1920 was carried on as a business of secondary importance by six companies primarily engaged in other branches of the fishery industry of Alaska. These companies, operating seven plants, reported an output of frozen salmon of 1,916,595

pounds, valued at \$161,143, an increase of 364,115 pounds in production and \$30,788 in value over corresponding quantities and values for 1919. This business represents no investment as distinguishable from that of the major activities of the companies concerned.

The output of frozen salmon was prepared by the following companies: Libby, McNeill & Libby, Sunny Point Packing Co., National Independent Fisheries Co., New England Fish Co., San Juan Fishing & Packing Co., and Booth Fisheries Co.

QUANTITY AND VALUE OF SALMON FROZEN IN ALASKA IN 1920, BY SPECIES.

Species.	Pounds.	Value.
Coho, or silver.....	134, 134	\$10, 624
Chum, or keta.....	448, 634	19, 049
Humpback, or pink.....	105, 816	7, 276
King, or spring.....	1, 143, 765	115, 770
Red, or sockeye.....	84, 246	8, 424
Total.....	1, 916, 595	161, 143

FRESH SALMON.

The trade in fresh salmon in Alaska declined markedly in 1920 as compared with 1919, a condition doubtless due to the shortened supply and the greater demand for salmon by the canneries. As heretofore, this business was carried on almost wholly in south-eastern Alaska and by operators more particularly engaged in other branches of the fishery industry. The bulk of the trade was represented by the business of the firms listed below:

Hoonah Packing Co.....	Hoonah.
Wrangell Cooperative Association.....	Wrangell.
Annette Island Packing Co.....	Metlakatla.
National Independent Fisheries Co.....	{ Juneau.
H. Bergman.....	{ Ketchikan.
Atlantic & Pacific Fisheries Co.....	{ Ketchikan.
Petersburg Cooperative Association.....	{ Port Alexander.
Ripley Fish Co.....	{ Douglas.
H. R. Thompson.....	{ Petersburg.
Juneau Cold Storage Co.....	{ Wrangell.
San Juan Fishing & Packing Co.....	{ Petersburg.
Karl Hansen.....	{ Ketchikan.
	{ Ketchikan.
	{ Juneau.
	{ Ketchikan.
	{ Port Alexander.

The total quantity of salmon sold fresh was 3,248,081 pounds, valued at \$263,264. This is 38 per cent less than the production in 1919.

PRODUCTS OF ALASKA FRESH-SALMON TRADE IN 1920.

Species.	Pounds.	Value.
Coho, or silver.....	273, 020	\$11, 784
Chum, or keta.....	242, 444	9, 032
Humpback, or pink.....	203, 444	3, 122
King, or spring.....	2, 474, 733	234, 474
Red, or sockeye.....	54, 440	4, 832
Total.....	3, 248, 081	263, 264

DRY SALTING OF SALMON.

The Kuskokwim Salmon Co., which was formed as a consolidation of the interests of the Kuskokwim Fishing & Transportation Co. and the Northern Fisheries (Inc.), on the Kuskokwim River, was engaged in the packing of dry-salted salmon in Alaska in 1920. The investment in miscellaneous supplies, small boats, fishing apparatus, and wages amounted to \$45,232. Employment was given to 28 whites and 15 natives. The products were as follows:

PRODUCTS OF THE DRY-SALTING SALMON BUSINESS IN ALASKA IN 1920.

Species.	Pounds.	Value.
Coho, or silver.....	42,200	\$4,642
Chum, or keta.....	7,800	884
King, or spring.....	152,640	28,140
Red, or sockeye.....	22,200	3,572
Total.....	224,840	37,535

There was an increase in production over 1919 of 12,596 pounds of dry-salted salmon, and in value of \$19,934.

DRYING AND SMOKING OF SALMON.

As a commercial undertaking the drying and smoking of salmon in 1920 was unimportant; the only reported products of that kind were 15,000 pounds of kippered salmon, valued at \$3,000, prepared by the Juneau Cold Storage Co., at Juneau, and 5,000 pounds of humpback salmon, valued at \$250, dried at Uyak by Peter Petrovsky.

Whites and natives living along the larger rivers of Alaska dry or smoke considerable quantities of salmon annually for local uses, but reliable figures of the number so used were not obtainable. These methods of preparing salmon were practiced chiefly in the Yukon Valley, where the inhabitants depend largely on such products for human needs and for dog food. In the coastal regions of Alaska, particularly those localities where winter temperatures are comparatively moderate, very limited quantities of salmon are dried or smoked. The possibility of taking cod and other sea foods at practically any time of the year obviates the necessity of preparing other fishery products for winter use.

SALMON BY-PRODUCTS.

The utilization of offal and waste material at the salmon canneries in Alaska in the manufacture of oil and fertilizer as a branch of the salmon industry revived somewhat in 1920, and was centered wholly in the southeastern district. Three companies were engaged exclusively in this business, while four were primarily concerned in the canning of salmon. In the first category are the Fish Cannery By-Products Co., which resumed operations at Ward Cove; the Alaska Reduction Co., which established a plant at Hawk Inlet; and the Petersburg By-Products Co., which operated at Scow Bay; in the other class were the Alaska Herring & Sardine Co., at Port

Walter; John L. Carlson & Co., at Auk Bay; Hoonah Packing Co., at Hoonah; and the Pacific American Fisheries, at Excursion Inlet and Ikatan.

The investment in this industry amounted to \$375,127. Employment was given to 90 whites, 23 natives, 13 Mexicans, and 13 others, or a total of 139 men.

In 1920 there were produced as salmon by-products 889 tons of fertilizer, valued at \$88,382, and 39,052 gallons of oil, valued at \$16,370. The total value of these products was \$104,752, an increase of \$85,106 over the value of similar products in 1919.

HALIBUT FISHERY.

Halibut are taken on banks of the North Pacific Ocean by vessels from ports of Washington, British Columbia, and Alaska. American vessels deliver their fares indiscriminately in those regions, controlling factors in the selection of a port of delivery being the market price of halibut and the cost of supplies. As the bulk of the catch of halibut in 1920 from Pacific waters was made on the high seas, beyond the jurisdiction of any country, Alaska is credited only with so much of the catch as was landed at her ports. Ordinarily this apportionment of the catch would tend to reduce the amount shown as the product of Alaska, for in recent years there was a marked diversion of fares to the more southerly ports, but in 1920 this condition was not so evident, there being a notable increase in the quantity of halibut handled through Alaskan ports. Deliveries in 1920 exceeded those of 1919 by 1,016,709 pounds.

STATISTICAL SUMMARY.

In arriving at the investment in the halibut industry as credited to Alaska an estimate was made of the value of all vessels, including apparatus, which made one or more landings of fares at ports in Alaska. In the same manner an estimate was made of the number of persons employed in this industry. On this basis the investment is given as \$2,270,722, an increase of \$291,265. The number of persons employed in the halibut fishery was 768, as against 867 in 1919. The production in 1920 was 15,295,500 pounds, valued at \$1,726,798, as compared with 14,278,791 pounds, valued at \$1,550,605, in 1919.

The companies which handled the bulk of the halibut exported from Alaska were the National Independent Fisheries Co., at Juneau and Ketchikan; Jack Bailey, Pacific Sea Products Association (Inc.), New England Fish Co., and the Ripley Fish Co., at Ketchikan; San Juan Fishing & Packing Co., at Seward and Ketchikan; and the Booth Fisheries Co., at Sitka.

INVESTMENT, PERSONS ENGAGED, AND PRODUCTS OF ALASKA HALIBUT FISHERY IN 1920.

Item.	Quantity.	Value.	Item.	Quantity.	Value.
INVESTMENT.			PERSONS ENGAGED.		
Fishing vessels:	<i>Number.</i>		Whites.....	<i>Number.</i> 744	
Steam and gas.....	102	\$1,281,246	Natives.....	24	
Net tonnage.....	1,954		Total.....	768	
Launches.....	35	53,400	PRODUCTS.		
Dories and scows.....	155	11,700		<i>Pounds.</i>	
Fishing apparatus.....		86,124	Fresh (including local).....	7,506,763	\$1,034,386
Shore property.....		357,833	Frozen.....	7,788,017	692,343
Cash capital.....		480,419	Canned (15 cases).....	720	75
Total.....		2,270,722	Total.....	15,295,500	1,726,796

HERRING FISHERY.

In the aggregate, the production of herring in Alaska in 1920 was greater than ever before, but there was a wide variation in the quantity of certain products as compared with the previous year. In 1919 approximately 52 per cent of the catch of herring was used in the preparation of pickled and canned herring and other food products. In 1920 almost 80 per cent of the catch of herring was used as bait or in the manufacture of fertilizer and oil. Of 15 companies handling herring in southeast Alaska, 7 were primarily operators of reduction plants, 6 were handling herring exclusively for bait, and 2, the smallest operators of all, were engaged wholly in the preparation of food products. In central Alaska the situation was decidedly different. There were 13 operators, all of whom were chiefly engaged in the preparation of food products, while 2 operated reduction works in connection with or supplemental to the packing of pickled herring. All herring taken in western Alaska were pickled; the limited output resulted from the operations of three packers at Golovin Bay.

STATISTICAL SUMMARY.

The herring industry shows an investment in Alaska of \$1,396,612, an increase of 55 per cent over the investment in 1919. Employment was given to 376 persons, as compared with 427 in 1919. Products were valued at \$1,303,614, as against \$1,676,170 in 1919, a decrease of \$372,556. Out of a total of 8,751,405 pounds of food products, approximately 94 per cent was prepared as Scotch-cured herring. This was an increase from 7,718,985 pounds in 1919 to 8,223,490 pounds in 1920, or 6½ per cent.

In the same period the Norwegian-cured product decreased from 2,216,120 pounds to 344,619 pounds, or approximately 84½ per cent.

INVESTMENT, PERSONS ENGAGED, AND PRODUCTS OF ALASKA HERRING FISHERY IN 1920.

Item.	Southeast Alaska.		Central Alaska.		Western Alaska.		Total.	
	Number.	Value.	Number.	Value.	Number.	Value.	Number.	Value.
INVESTMENT.								
Plants operated.....	5	\$139,670	7	\$284,828	2		14	\$424,498
Operating capital.....		243,694		549,443		\$3,050		796,187
Vessels:								
Power vessels over 5 tons.	8	35,433	11	63,500			19	98,933
Net tonnage.....	195		233				428	
Launches under 5 tons...	1	2,000	6	8,300			7	10,300
Boats, row and seine...	15	1,400	36	2,835	1	80	52	4,315
Lighters and scows.....	3	4,900	8	9,100			11	14,000
Pile drivers.....	1	1,500	1	3,000			2	4,500
Apparatus:								
Beach seines.....	4	2,300	9	7,050			13	9,350
Fathoms.....	215		1,135				1,350	
Purse seines.....	8	12,440	9	18,500	1	350	18	31,299
Fathoms.....	1,510		1,770		100		3,380	
Gill nets.....			17	2,450	24	780	41	3,230
Fathoms.....			850		400		1,250	
Total.....		443,346		949,006		4,260		1,396,612
PERSONS ENGAGED.								
Fishermen:								
Whites.....	52		67				119	
Natives.....	2				1		3	
Others.....	4						4	
Total.....	58		67		1		126	
Shoresmen:								
Whites.....	42		166				208	
Natives.....	27		1		2		30	
Others.....	8						8	
Total.....	77		167		2		246	
Transporters: Whites.....			4				4	
Grand total.....	135		238		3		376	
PRODUCTS.								
Canned (1-pound cans).....							¹ 3,602	28,980
Fresh for food.....							² 2,400	105
Fresh for bait.....							³ 1,559,100	21,167
Frozen for bait.....							² 2,525,700	20,027
Pickled for food, Scotch cure.							³ 8,223,490	490,485
Pickled for food, spiced.....							² 8,000	400
Pickled for food, Norwegian cure.							³ 344,619	22,199
Fertilizer.....							² 6,078,000	310,161
Oil.....							² 681,067	404,090
Total.....								1,303,614

¹ Cases.² Pounds.³ Gallons.

COD FISHERY.

The changes of note in the cod industry of Alaska in 1920 were increases in production of 17 per cent, 14 per cent in number of persons employed, and 60 per cent in investment. These expansions are recorded notwithstanding the withdrawal of J. A. Matheson, of Anacortes, Wash., who for many years was listed as an important operator in the vessel fishery of western Alaska. The Bering Sea Fisheries Co. appears as a new concern in this industry, but in reality it is understood to be only an organization of the interests previously

shown under the name of Lars Mikkelsen. Operations by the Pacific American Fisheries in the vicinity of Unimak Island and W. J. Erskine Co. in the Kodiak region account largely for the increased production of cod in 1920 over that of 1919. It is noteworthy that approximately 28 per cent of the cod taken in Alaskan waters was reported as of shore-station catch. Generally the smaller producers of cod are the operators of shore stations only.

The Alaska cod industry is facing a decline of serious proportions in view of the active competition which has developed rather recently through deliveries of cod by Japanese vessels. Under present conditions this competition bids fair to increase to the great disadvantage of the Alaska cod industry.

VESSEL FISHERY.

Owing to the withdrawal of J. A. Matheson, the schooner *Fanny Dutard* does not appear in the list of vessels forming the cod fleet of 1920. The *Chas. R. Wilson*, a schooner heretofore listed as one of the vessels of the Pacific Coast Codfish Co., was also withdrawn from the Alaska field. Offsetting these withdrawals are two notable additions to the list of vessels in the fleet of 1920. One was that of the schooner *S. N. Castle*, belonging to the Alaska Codfish Co., and the other that of the schooner *Carolyn Frances*, owned by the Union Fish Co., which company further increased its fleet by adding the schooners *Eunice*, *Mary E.*, *Chas. E. Brown*, and the power schooner *Progress*. The W. J. Erskine Co. reported nine small vessels engaged in cod fishing at Kodiak, two of which were listed in 1919. The Alaska Codfish Co. added the *Alasco IV* to its fleet of small power vessels in Alaska.

The fleet in 1920 was composed of 36 vessels, 16 of which were schooners of more than 100 tons register. This is an increase of 11 over the number listed in 1919. The total tonnage of the fleet in 1920 was 5,171 net tons, as compared with 4,234 net tons in 1919.

SHORE STATIONS.

The important shore stations of Alaska were operated and located as follows: O. Kraft & Son at Kodiak; the Union Fish Co. and the Alaska Codfish Co. at several stations in the Shumagin and Sanak Islands; the Bering Sea Fisheries Co. at Unga; and four stations in the Aleutian Islands Reservation.

ALASKA COD FLEET IN 1920.

Name.	Rig.	Net tonnage.	Operators.
City of Papeete.....	Schooner.....	370	Alaska Codfish Co., San Francisco, Calif.
Gendale.....	do.....	281	Do.
Maweema.....	do.....	302	Do.
S. N. Castle.....	do.....	464	Do.
Alasco.....	Power schooner.....	23	Do.
Alasco II.....	do.....	5	Do.
Alasco III.....	do.....	8	Do.
Alasco IV.....	do.....	14	Do.
Trio.....	do.....	9	Alaska Ocean Food Co., Seattle, Wash.
Dora.....	Steamer.....	217	Bering Sea Fisheries Co., Seattle, Wash.
Lister.....	Power schooner.....	15	W. J. Erskine Co., Kodiak, Alaska.
Pilgrim.....	do.....	8	Do.
Northern King.....	do.....	8	Do.
Patmos.....	do.....	17	Do.

ALASKA COD FLEET IN 1920—Continued.

Name.	Rig.	Net tonnage.	Operators.
Edith.....	Power schooner.....	7	W. J. Erskine Co., Kodiak, Alaska.
Buffalo.....	do.....	15	Do.
Floesie.....	do.....	6	Do.
Nimrod.....	do.....	8	Do.
North Star.....	do.....	15	Do.
John A.....	Schooner.....	235	Pacific Coast Codfish Co., Seattle, Wash.
Maid of Orleans.....	do.....	171	Do.
Alice.....	do.....	220	Robinson Fisheries Co., Anacortes, Wash.
Wawona.....	do.....	413	Do.
Golden State.....	Power schooner.....	223	Union Fish Co., San Francisco, Calif.
Eunice.....	Schooner.....	35	Do.
Progress.....	Power schooner.....	115	Do.
Mary E.....	do.....	21	Do.
Chas. E. Brown.....	Schooner.....	64	Do.
Carolyn Frances.....	do.....	422	Do.
Sequoia.....	do.....	324	Do.
Galilee.....	do.....	328	Do.
Beulah.....	do.....	339	Do.
Louise.....	do.....	328	Do.
Martha.....	do.....	14	Do.
Pirate.....	Power schooner.....	30	Do.
Union Flag.....	do.....	7	Do.

STATISTICAL SUMMARY.

The total investment in the cod industry of Alaska in 1920 was \$2,057,728, as compared with \$1,286,075 in 1919, an increase of \$771,653. Employment was given to 803 men, as against 702 in 1919. The production of cod in 1920 was 12,763,899 pounds, valued at \$1,117,464, being an increase over the output of 1919 by 1,870,587 pounds and \$291,474 in value.

INVESTMENT, PERSONS ENGAGED, AND PRODUCTS OF ALASKA COD FISHERY IN 1920.

Item.	Quantity.	Value.	Item.	Quantity.	Value.
INVESTMENT.			PERSONS ENGAGED—contd.		
Value of shore stations.....		\$405,583	<i>Number.</i>		
Cost of operations.....		490,229	Transporters: Whites.....	41	
Wages paid.....		440,384	Grand total.....	803	
Vessels:			PRODUCTS.		
Power vessels over 5 tons.....	20	232,912	<i>Pounds.</i>		
Net tonnage.....	767		Vessel catch:		
Sailing.....	16	340,074	Dry-salted cod.....	8,887,339	\$712,948
Net tonnage.....	4,400		Pickled cod.....	168,730	10,123
Launches.....	115	67,373	Fresh cod.....	565	23
Dories.....	371	17,761	Tongues.....	16,600	1,244
Pile drivers.....	3	3,603	Total.....	9,073,234	724,338
Apparatus:			Shore-station catch:		
Selnes (75 fathoms).....	1	250	Dry-salted cod.....	1,949,982	219,162
Gill nets (75 fathoms).....	1	195	Pickled cod.....	1,726,908	171,524
Lines.....	472	19,364	Stockfish.....	12,775	2,300
Total.....		2,057,728	Tongues.....	1,000	140
PERSONS ENGAGED.			Total.....	3,690,665	393,126
Fishermen:			Total:		
Whites.....	695		Dry-salted cod.....	10,837,321	932,110
Natives.....	38		Pickled cod.....	1,895,638	181,647
Total.....	733		Fresh cod.....	565	23
Shoresmen:			Stockfish.....	12,775	2,300
Whites.....	27		Tongues.....	17,600	1,384
Natives.....	2		Grand total.....	12,763,899	1,117,464
Total.....	29				

The known losses in the cod industry were comparatively small. Three fishermen were drowned and one shoresman was accidentally killed. The loss of small boats and fishing tackle, valued at \$10,461. and the loss of the steamer *Dora*, owned by the Bering Sea Fisheries Co., and valued at \$50,000, were reported. The *Dora* was wrecked on December 20, 1920, at Hardy Bay, on the northeast coast of Vancouver Island, B. C., and thus, after 40 years of almost continuous service, at times under very trying conditions, there was lost the most historic vessel plying Alaskan waters.

WHALE FISHERY.

SHORE STATIONS.

Whaling operations in Alaska in 1920 were carried on by four companies, namely, United States Whaling Co., at Port Armstrong; North Pacific Sea Products Co., at Akutan; J. A. Magill & Co., at Beluga River, on Cook Inlet; and the Arctic Whaling & Fishing Co., at Golovin Bay.

The North Pacific Sea Products Co. operated four steam whaling vessels, the *Kodiak* and *Unimak* (each 99 tons net), *Tanginak* (71 tons net), and the *Paterson* (77 tons net). It also used the barge *Fresno* (1,149 tons net) and the steamer *Elihu Thomson* (449 tons net) as transporting vessels. Its operations were carried on in the waters of the Pacific Ocean and Bering Sea contiguous to the Aleutian Islands. Four species of whales were taken—the finback, humpback, sulphur-bottom, and sperm—almost half of the catch being finbacks. A total of 290 whales was taken by this company.

The United States Whaling Co. operated in the coastal waters of southeastern Alaska from Dixon Entrance to Cross Sound, the important hunting ground paralleling the coast at an approximate distance of 25 miles. Three steam whaling vessels were engaged in the hunting of whales. They were *Star I* (133 tons net) and *Star II* and *Star III* (each 97 tons net). A total of 139 whales was taken. Five species were represented, the sei whale being secured in addition to the four species taken in western Alaska.

J. A. Magill & Co. operated the plant on Beluga River, formerly controlled by the Beluga Whaling Co. This company captured 100 belugas or white whales, this being by far the most successful season experienced at that station.

The Arctic Whaling & Fishing Co. operated in the vicinity of Nome and succeeded in capturing 136 belugas.

STATISTICAL SUMMARY.

The whaling industry of Alaska shows an investment of \$1,700,910 in 1920, a decrease of \$89,957 from 1919. It gave employment to 318 men, or 7 more than in 1919. Whale products were valued at \$562,302, as compared with \$1,027,200 in 1919. The total number of whales taken was 665, or 85 more than in the preceeding season.

INVESTMENT, PERSONS ENGAGED, AND PRODUCTS OF ALASKA SHORE WHALING OPERATIONS IN 1919.

Items.	Number.	Value.	Items.	Number.	Value.
INVESTMENT.			PRODUCTS.		
Vessels:			Whales:		
Steam and gas.....	9	\$471,000	Pinback.....	179	
Net tonnage.....	1,121		Humpback.....	75	
Barge.....	1	30,000	Sulphur-bottom.....	81	
Net tonnage.....	1,149		Sperm.....	90	
Launches under 5 tons.....	5	6,400	Sel.....	4	
Row boats.....	19	1,300	Beluga.....	236	
Scows.....	5	2,800			
Pile driver.....	1	150	Total.....	665	
Value of plants.....		366,246			
Cash capital.....		546,946	Whale oil.....	1 765,309	\$304,256
Wages paid.....		276,008	Sperm oil.....	1 343,611	131,783
Total.....		1,700,910	Fertilizer, meat.....	1 218	101,105
			Fertilizer, bone.....	1 377	28,815
PERSONS ENGAGED.			Whalebone.....	1 17,484	6,118
Whites.....	239		Ivory, sperm.....	1 750	225
Natives.....	46		Total.....		562,302
Japanese.....	33				
Total.....	318				

1 Gallons.

1 Tons.

1 Pounds.

CLAM CANNING.

A few years ago the canning of clams in Alaska gave promise of becoming an industry of some consequence, as it was then generally held that the areas occupied by clams were reasonably extensive, fairly accessible, and that they might support an independent industry for some time to come; but to date almost no attempt has been made to develop clam fisheries at any other locality than the Cordova district. Production in that field began to decline in 1919. The results of operations in 1920, with only one company packing clams at Cordova as against three in 1918, show that this decline is still in progress. In addition to the exhaustion of the clam beds it was also apparent that the increasing cost of the raw product to the packers was a vital factor in the life of the industry. Owing to the diminution in the supply of clams the diggers encountered greater difficulty in making wages, which necessitated a demand from them for a higher rate per pound for clams.

Clam canning was carried on by the Pioneer Packing Co., at Cordova; Surf Packing Co., at Chisik Island, Cook Inlet; and the Douglas Island Packing Co., at Douglas. These companies were also engaged in canning salmon, for which reason the plant investment is credited to that industry. There were employed 57 diggers, to whom wages amounting to \$9,387 were paid. A total of 6,833 cases of clams and clam juice was prepared, the value of which was \$46,812.

PRODUCTS OF ALASKA CLAM-CANNING INDUSTRY IN 1920.

Items.	Cases.	Value.
Minced clams:		
1-pound cans (48 per case).....	424	\$3,384
No. 1 eastern oyster cans (48 per case).....	5,876	41,132
1-pound cans (48 per case).....	17	136
2-pound cans.....	380	1,748
Clam juice, 8-pound cans.....	136	412
Total.....	6,833	46,812

MINOR FISHERIES.

TROUT.

The output of trout in Alaska in 1920 was practically equal in quantity and value to that of 1919, when it was valued at \$13,155 as against \$13,662 in the past year. Southeastern Alaska led in production, as approximately but 20 per cent of the catch came from central and western Alaska, as compared with 27 per cent from those districts in 1919 and 79 per cent in 1918. The chief factor contributing to this result was the continued closure of the cannery of the Midnight Sun Packing Co., at Kotzebue Sound, where a few thousand cases of Dolly Vardens were canned annually prior to 1919.

The bulk of the catch of both steelhead and Dolly Varden trout was handled as fresh or frozen fish by the Ripley Fish Co., and Libby, McNeill & Libby, in southeastern Alaska. All canned trout came from central and western Alaska. No investment is credited to this business, as all operations were incidental to halibut and salmon industries.

PRODUCTS OF ALASKA TROUT FISHERY IN 1920.

Section and species.	Fresh.		Frozen.		Pickled.		Canned.	
	Pounds.	Value.	Pounds.	Value.	Barrels.	Value.	Cases.	Value.
Southeast Alaska:								
Steelhead.....	26,751	\$1,414	17,344	\$2,601				
Dolly Varden.....	26,326	6,726	250	25	5	\$75		
Total.....	53,077	8,140	17,594	2,626	5	75		
Central:								
Steelhead.....							427	\$2,126
Dolly Varden.....	3,420	342	379	20	5	75		
Total.....	3,420	342	379	20	5	75	427	2,126
Western Alaska: Dolly Varden.....							43	258
Grand total.....	56,497	8,482	17,973	2,646	10	150	470	2,384

SABLEFISH.

As may be generally known, the catch of sablefish each year is made almost wholly by halibut fishermen operating in the offshore waters of Alaska, and the quantity reported annually fluctuates with market demands and the willingness of the fishermen to utilize space in their boats for sablefish which might be filled more profitably with

halibut. In 1920 the production of sablefish reached a total of 584,251 pounds, valued at \$28,544. There was an increase of 74,882 pounds in products but a decline of \$6,941 in value from the corresponding figures reported in 1919. Statistics show that 565,926 pounds, valued at \$27,770, were frozen; 3,000 pounds, valued at \$140, were pickled; and 15,325 pounds, valued at \$634, were shipped fresh to the States.

CRABS.

Some change was noted in 1920 with respect to the utilization of crabs in Alaska. The Arctic Packing Co. and Eda O. Kitzman canned experimentally a few cases of crabs at Seldovia, in central Alaska. John Murphy, at Tenakee, was the only operator engaged in crab fishing in southeastern Alaska. The investment in the crab fishery was \$750. The products were 70 cases of canned crabs, valued at \$1,050, and 6,350 pounds of crabs sold fresh for \$690. The total value of all crab products was \$1,740.

SHRIMPS.

Encouraging interest in the shrimp fishery of southeastern Alaska was manifested in 1920 by the Alaskan Glacier Sea Food Co., at Petersburg. The investment in the shrimp industry was reported as \$76,100, of which amount \$24,500 was paid in wages to 14 whites, 5 natives, 20 Japanese, and 1 Mexican. Four boats and six trawls, valued at \$29,600, were operated in this fishery. The total production of shrimp was 112,045 pounds, valued at \$49,123. The products of this fishery were more than double those of 1919, and it would therefore seem that the competition of the southern shrimp fisheries had not seriously affected operations in Alaska.

MISCELLANEOUS FISHERY PRODUCTS.

This classification of products includes red rockfish, flatfish, and smelts. Products aggregated 11,073 pounds, valued at \$229, practically all of which were frozen.

FUR-SEAL INDUSTRY.

PRIBILOF ISLANDS.

GENERAL ADMINISTRATIVE WORK.

In 1920 the work of the Bureau at the Pribilof Islands was carried on in the usual manner. Sealing operations were upon practically the same scale as in the previous year, but a more extensive study of experimental methods in taking and curing skins was made, the results of which will be applied upon a commercial scale in succeeding seasons. The take of pelts from the blue fox herds was the largest for many years. Progress was made in construction work, additional housing facilities being provided for natives on St. Paul Island and increased salt house and workshop space on both islands to handle larger takes of fur-seal and fox skins. The census of the fur-seal herd was taken as usual. The annual supplies for the islands were transported chiefly by the Navy Department, but considerable assistance was given by Coast Guard vessels, and the Bureau's vessel *Eider* rendered valuable service between Unalaska and the Pribilofs.

PERSONNEL.

Effective July 1, Agent and Caretaker A. H. Proctor, of St. Paul Island, was appointed to the new position of superintendent, Pribilof Islands, to have general direction of the work on the two islands. Storekeeper H. D. Aller, who had been detailed to the Washington office during the previous winter, was appointed agent and caretaker of St. Paul Island, arriving there October 26 on the U. S. S. *Saturn*. When Agent and Caretaker Charles E. Crompton left for the States September 9 on the *Saturn*, St. George Island was placed in charge of Storekeeper E. C. Johnston. After taking leave of absence, Mr. Crompton proceeded east via St. Louis, arriving at the Washington office January 5, 1921, for duty through the winter. School-teacher E. C. Johnston, of St. George Island, was appointed storekeeper, effective April 27; he was succeeded by Carl E. Fletcher, who reached the island on the *Saturn* June 16, and, having tendered his resignation, left on the same vessel in October. John M. Orchard was then appointed school-teacher of St. George Island and arrived there on the *Saturn* October 29. Herschel Silverstone, assistant to the agent on St. Paul Island, tendered his resignation and left by the Coast Guard cutter *Bear* in October. Mr. Silverstone was succeeded by Henry Mygatt, who arrived on the *Saturn* October 26. Assistant Agent H. C. Scudder was appointed storekeeper on St. Paul Island, arriving there October 26. George Haley resigned as school-teacher

on St. Paul Island and left the islands on the *Saturn* in June. Mr. Haley was succeeded by Richard Culbertson, who arrived at St. Paul Island on the *Saturn* June 17. Dr. Washington C. Huyler was appointed physician for St. Paul Island, but resigned soon after his arrival and returned on the *Saturn* in November. Dr. J. J. Richstein, resigned, left St. Paul Island at the same time. Dr. G. B. Bowlby was appointed to succeed Dr. Huyler and was en route to the island via Kodiak at the close of the year. Warden Joseph N. Braun arrived at St. George Island on the *Algonquin* September 19, having been detailed for general duty there during the winter.

In the list of temporary employees was Dr. G. Dallas Hanna, curator of invertebrate paleontology at the California Academy of Sciences and formerly in the Alaska service of the Bureau, who arrived at the islands on the *Saturn* June 16 and left on the same vessel September 9; in the interim he was engaged in taking the annual census of fur seals, making several trips between the islands. Dr. H. A. Swanson was employed as a dentist for several months, spending part of his time on each island. W. C. Allis, special assistant on St. Paul Island, left there in October for a winter in the south, having been on the island since early in 1919. H. A. Peterson, sealing assistant, arrived on the *Saturn* in June and remained for the winter. Messrs. W. P. Zschorna, F. L. Milligan, O. E. Klockenbrink, M. Syron, and J. H. Quatmann, employees of Funsten Bros. & Co., of St. Louis, spent the summer on the island in connection with experimental work in improving methods of handling and salting seal-skins. Mr. Milligan spent part of his time on St. George Island. Andrew Pearson and Ole Holum, carpenters, were on hand from May until November; the former was continuously on St. Paul Island but the latter was sent to St. George Island for a few weeks.

Ward T. Bower, of the Washington office, visited the islands during the summer for the purpose of getting in closer contact with the activities there, reaching the islands July 1 and leaving July 18. Passage between the islands and King Cove was furnished by the Bureau's vessel *Eider*, and between King Cove and Seattle by commercial vessels.

PURCHASE AND TRANSPORTATION OF SUPPLIES.

As in previous seasons, printed schedules of annual supplies of general merchandise required for the Pribilof Islands were prepared and competitive bids received for the sale and delivery of the goods at Seattle, Wash. Through the courtesy of the Navy Department the radio tender *Saturn* was made available for the transportation of the annual supplies, the vessel making two trips to the islands to complete the work.

On the first trip the *Saturn* had considerable cargo for the radio stations, hence only part of the Bureau's supplies could be taken. On this voyage the vessel sailed from Seattle August 8, carrying 260 tons of general supplies, 77,000 feet of lumber, and 225 tons of coal for St. George Island; and a shipment of empty barrels, 80 tons of coal, and a few tons of general merchandise for St. Paul Island. Owing to unusually severe weather conditions, however, but very little of this cargo was discharged at the Pribilofs, the major portion

being unloaded at Dutch Harbor. The vessel then returned to Bremerton and Seattle, leaving the latter place October 13 with the balance of the supplies. This cargo, and a part of that which had been left at Dutch Harbor, was landed at the islands under adverse conditions. The lumber and some of the coal purchased for St. George Island remained at Dutch Harbor.

During the summer and fall the vessels *Unalga* and *Algonquin* of the Coast Guard very courteously assisted the islands in the transportation of coal and much-needed supplies from Unalaska and Dutch Harbor.

The Bureau's tender *Eider* made a trip to the islands in the month of September and again in October, carrying staple foodstuffs and coal to relieve the shortage which existed until the arrival of the *Saturn* on her second trip.

POWER SCHOONER "EIDER."

The Bureau's power schooner *Eider*, which was purchased and sent to Alaska late in 1919 as a tender for the Pribilof Islands, thoroughly demonstrated its value in the calendar year 1920, making in all 11 round trips between Unalaska and the islands and 2 trips to King Cove from Unalaska before it became necessary in November for the vessel to proceed to Kodiak for certain urgent repairs. All told, 7,959 miles were covered during the year. As Bering Sea is not generally navigated during the winter months and a vessel operating there would be unable to secure assistance in distress, all precautions possible were taken for the safety of the craft during periods of severe weather. Trips to the islands were made as follows: One in January, two in April, one in May, one in June, three in July, one in August, one in September, and one in October. Trips to King Cove were made in June and July.

Early in April the *Eider* transported a special shipment of 1,312 fur-seal skins and 938 fox skins from the islands to Unalaska, from which place they were taken by the commercial steamer *Victoria* to Seattle. The second trip in April from Unalaska to the islands was chiefly to deliver fuel oil for the naval radio stations. During the season the vessel transported general cargo and carried passengers for the radio stations as well as white employees and native workmen of the Bureau's service between Unalaska and the islands, and was also used at St. Paul Island to transfer salted sealskins from Northeast Point to the village. Naval stores were carried on a number of trips by the vessel. The better mail service between the islands and Unalaska, the nearest post office, was of special value.

On October 18 the *Eider* was placed under quarantine for smallpox, of which there was a rather serious outbreak at Unalaska. After the quarantine was lifted the vessel aided in landing cargo from the *Saturn* and otherwise acted as tender for that vessel until again quarantined when a case of smallpox developed aboard the *Eider* November 10. After clearing the second quarantine the *Eider* left for Kodiak November 28 for repairs and to furnish transportation to a physician for St. Paul Island on the return trip. The vessel was at Kodiak at the end of the year.

The officers and crew of the *Eider* deserve commendation for making hazardous trips to the islands during the winter season and at times of the year when no vessel ever before was at the Pribilofs.

DEPARTMENTAL ORDER REGARDING VISITING OF FUR-SEAL ROOKERIES.

For the purpose of definitely regulating the movements of persons temporarily or otherwise present at the Pribilof Islands, the following order was issued by the Secretary of Commerce on March 2, 1920, and the regulations therein were put into effect at the islands during the summer of 1920:

Section 293, Compiled Laws of Alaska, 1913, provides that it shall be unlawful for any person to land or remain on any of the Pribilof Islands, except through stress of weather or like unavoidable cause or by authority of the Secretary of Commerce.

In order that the interests of the Government may be properly served in the matter of protecting the fur-seal rookeries from unnecessary disturbance and in the matter of avoiding the driving of hauling-ground seals into the water, the following regulations are hereby promulgated:

1. Persons lawfully landing, whether to remain temporarily or otherwise, must confine themselves to their lawful activities, and any visiting of rookeries or hauling grounds of seals or sea lions must first be authorized by the Department's agents in charge.

2. In order that persons authorized or permitted to land may have an opportunity to observe seal life, the Department's agents in charge will provide escorts, when practicable, to accompany interested persons to proper observation points. No side digressions from the designated observation points will be permitted. There will be no visiting of rookeries except under such escorts. On St. Paul Island the usual observation point for persons temporarily present shall be what are commonly known as "Observation Rocks" at Gorbach rookery.

3. Persons authorized to land at St. Paul Island, whether to remain temporarily or otherwise, are required, except under circumstances specifically authorized by the Department's agent in charge, to remain on that portion of the island in and about the village of St. Paul which is bounded by the shore line, including that of the salt lagoon and its outlet, and two straight lines running approximately as follows: The first from the shore at Black Bluffs to the southerly portion of the salt lagoon, passing to the eastward of the natives' cemetery, the natives' wells, and the by-products plant; the second to cut across the isthmus at Zolotoi Sands. The land lines as described will be indicated by notices posted at suitable intervals.

4. Any person willfully violating these regulations will be regarded as a trespasser and will be required to leave the islands at the first opportunity, or will be subject to such other action as may be deemed appropriate.

The above rules have become necessary primarily because of the great importance of nondisturbance of hauling ground seals during the few weeks of active commercial sealing when a thoughtless intrusion upon the seals of that class might mean a large financial loss to the United States. The unnecessary disturbance of seals on their breeding areas is also quite undesirable. Signs designating the limits of the unrestricted district in the vicinity of the village were posted on St. Paul Island, and on St. George Island a definite observation point was selected and marked where visitors, under escort, might see the rookery life without disturbing seals of any class.

CONSTRUCTION WORK.

Considerable construction work has been accomplished at the Pribilofs during the year. On St. Paul Island a new salt house was com-

pleted, a concrete native dwelling was built, and two frame houses for natives were completed. Some of this work had been started the previous year. A garage to house the four tractors on St. Paul Island was built. A concrete extension to the wharf was completed. There is more work to be done along this line as soon as time and funds permit. Various repairs to native dwellings, improvements at the by-products plant, the construction of outhouses, and minor matters were given attention. A road grader was sent to St. Paul Island and some work in improving roads was undertaken.

On St. George Island an extension to the wharf was completed and the landing slip was enlarged, thus facilitating the discharge of small boats lightering cargo ashore. Also some blasting was done at East Landing, thus making possible the construction of a short roadway for handling boats. Preliminary work, including completion of excavation, was done toward the construction of a combined shop and warehouse urgently necessary to provide storage and handling space for the increased take of fox skins. The kenches in the old salt house were transferred to the new salt house, thus bringing sealskin work into a single building. Alterations were made at the fox house to allow trapping, regardless of the direction of the wind.

USE OF TRACTORS.

The four tractors which were forwarded to St. Paul Island on the supply vessel late in 1919 were used during the season of 1920 with satisfactory results. They were employed, with trailers, for general hauling in and about the village, hauling sealskins from the killing fields to the salt houses and moving carcasses to the by-products plant. Also they were found to be of great value in handling the large quantities of lumber, coal, and general cargo landed from the supply ship, and which, owing to the uncertainty of weather conditions in Bering Sea, must be landed and stored as rapidly as possible. In conjunction with a road grader and trailers the tractors rendered good service in the construction of roads.

BY-PRODUCTS PLANT.

The by-products plant on St. Paul Island was operated during a part of the summer of 1920. A shortage of coal made it necessary to close the plant much earlier than had been originally intended. During the period the plant was in operation it produced approximately 19,000 pounds of fertilizer meal and 1,853 gallons of oil, of which 361 gallons were No. 1, 1,299 gallons No. 2, and 193 gallons No. 3. A shipment of 15,393 pounds of meal produced this season was sold at Seattle for \$68 per ton, bringing a total of \$523.36; the remainder of the meal is still at the island. The oil is in storage at Seattle pending decision as to its most advantageous disposition; the market for this product was very poor at the close of the year.

During the summer of 1920 an experiment was conducted to determine the comparative values of oil rendered from the carcasses of seals which had been dead for different lengths of time. It was considered possible that in the cool climate of the Pribilofs the factor of decomposition might be of less consequence than is the case where

animal oils are handled in warmer regions. Accordingly samples were taken of oil rendered from carcasses of seals which had been dead 1, 2, 3, 4, 5, 6, 7, 10, 11, and 12 days, and these were later forwarded to the Bureau of Standards.

The report on the analyses showed that with seal blubber, as in other animal fats, a decided increase in free fatty acids takes place within a very few days. The acid number of the seal oil samples ranged from a minimum of 2.8 for the first two days to a maximum of 13.3 on the tenth day after killing. Reference to the New York market quotations at the end of the year showed a price of 45 cents per gallon for herring oil containing less than 5 per cent of acids, while only 28 cents per gallon was offered for the same oil containing between 5 and 10 per cent of acids. The seal-oil samples taken 10, 11, and 12 days after killing showed an average acid number of 11.2, and the samples for the third, fourth, fifth, sixth, and seventh days had an average acid number of well over 5. In view of the great depreciation in value of oils having a high acid content, it is of primary importance that the oil be rendered from the animal tissues as early as practicable. Other features of the analyses did not show progressive changes on which sound conclusions could be based.

IMPROVED SEALING METHODS.

With a view to securing improvement in the quality of the seal-skins prior to the dressing and dyeing processes, the study of sealing methods at the islands was continued in 1920. W. P. Zschorna, who carried on preliminary work in 1919 for the Bureau, was in charge of experimental work this year for Funsten Bros. & Co. Four other employees of the company, namely, Michael Syron, Oliver E. Klockenbrink, Frank L. Milligan, and J. H. Quatmann, were detailed for duty at the Pribilofs during the active sealing season and assisted in this special work. Particular attention was given the features of blubbering and washing the raw pelts before salting, and of salting the skins only once instead of twice, as formerly. While this work was of an experimental character, it was on a scale sufficiently large to warrant its being used as the basis for making changes if any were found to be desirable.

The method of handling raw sealskins in effect for many years was to allow them to lose their natural heat while lying on the killing field. They were then taken to the salt houses, and at the end of five days were removed, examined for faulty curing, and returned to the salt to await shipment, usually at least five or six weeks later. In the summer of 1920, however, 1,000 skins were given different treatment on St. Paul Island. Immediately after killing, or as soon as they could be hauled in from the killing fields, these skins were cooled in a tank of running sea water; all blubber and meat was carefully removed, they were again washed, and then were stretched and placed in salt to remain until removed for shipment. Advance reports on these skins indicate that they are of such an improved quality as to warrant the extension of the washing, blubbering, and stretching of the pelts to the whole take of skins.

A feature of the new plan is the taking of sealskins by the so-called rough method, which consists in leaving considerable quanti-

ties of blubber and meat on the pelt when it is removed from the animal. In addition to securing more evenly cured skins, the new method does away with the chances for cutting or flaying the skins on the killing field as the subsequent removal of the blubber and meat makes it unnecessary for the skinner to cut close to the pelt. The following comments by the Gibbins & Lohn Dressing & Dyeing Co., of St. Louis, in regard to the blubbered and washed skins of 1920, show some of the practical advantages of the new treatment:

The benefit of the better curing and more uniform condition of the pelts is apparent throughout the various dressing processes. The washing is rendered easier, more efficacious, and safer than on ordinary skins. The better condition of the pelts is also felt in the unhairing process. The hair on the yellow spots is always quite difficult to remove. It is generally necessary on such pelts to loosen the hair by a slight and controlled sweating action, which can not be advantageous, for it has a tendency to loosen fur as well as hair. It was found that in the white-blubbered pelts the hair could be loosened by the unhairing process and the fur left firmer and set tighter when the process was finished. In other words, the hair was easier to remove because the fur held firm. Another result is that more of the fine hair is removed during the unhairing. While this fine hair can be clipped out during the subsequent machining process, a better finished product is obtained if it is removed during the unhairing.

In addition to the skins which were washed and blubbered, a portion of the catch was handled in the usual manner and then cooled by washing before salting; others were given no special treatment beyond a stretching at the time of salting. Various small lots of skins were treated in different ways, the entire effort being toward developing improved methods.

It is probable that the blubbering, washing, stretching, and single salting will be conducted on a larger scale in the season of 1921, as there is every reason to believe that the new methods result in a superior finished product.

NATIVES.

HEALTH CONDITIONS.

The maintenance of good health among the natives on the Pribilof Islands is not only one of the responsibilities resting upon the Bureau in its administration of affairs there, but it is greatly to the interest of the Government to give the best of care to the communities which perform the bulk of the manual labor incidental to the valuable and remunerative industries centering on the islands.

A resident physician is stationed on each of the two islands primarily for the purpose of attending to the health of the natives. Well-stocked dispensaries are provided and a small hospital is available on St. Paul Island. A building to contain hospital facilities is to be constructed on St. George Island in the near future.

During the summer and fall of 1920 a dentist was employed to give attention to the needs of the natives and others on the Pribilofs and he was fully occupied during his entire stay. Another dentist will be secured for the coming year to continue this important work.

It is especially noteworthy that on St. George Island, with a population of about 135 persons, no deaths occurred for a period of 15 months ending June 19, 1920. This is unprecedented in the history of the Pribilofs.

SCHOOLS.

St. Paul Island.—The senior school on St. Paul Island, under the direction of George Haley, was opened on September 22, 1919, and continued until May 28, 1920. The enrollment consisted of 66 pupils. The usual methods were followed in the teaching of the children, particular stress being placed upon subjects which would tend to bring about the increased use of the English language. In resigning at the close of the session, Mr. Haley terminated a period of service in the island schools extending over six years.

St. George Island.—On St. George Island the senior school was opened on October 7, 1919, and closed May 14, 1920, with an enrollment of 34 pupils. The percentages of attendance and punctuality were 99.45 and 99.52, respectively. In discussing the methods of instruction and administration used in the school, Mr. Johnston states:

The pupils were divided into five general classes and again subdivided where necessary. These subdivisions varied with the different subjects of instruction, but were determined more by the intelligence and capabilities of the pupils.

The use of English was always required in the schoolroom. Several days sometimes passed without a word of Aleut being spoken. At recess and at home the pupils were encouraged to speak English.

When the Aleut children can understand English with more ease and quickness, especially as it is spoken, they will advance in their other studies at a surprisingly rapid rate. This inability to understand many explanations given by the teachers, no matter how simple they are, makes such studies as arithmetic difficult. In every recitation the study and use of English was of paramount importance.

In the fourth and fifth reading classes the text was discussed and commented upon by the pupils so that they would understand the English phraseology. The lower classes were given drills in vocabulary and pronunciation. Compositions on stories in the readers were rather poor, as it seemed hard for most of the children to grasp the important points of a story. The following will illustrate: In the geography textbook a paragraph would describe a river system. The final sentence of the description would be: "This is called a river system." The pupils, in spite of continuous instruction, would give the sentence quoted above as the definition of a river system.

Compositions were frequently called for, the subjects being chosen by the pupils or by the teacher. Letters were written to friends at other places. All written work was corrected and handed back to be rewritten or discussed in class.

During the second half of the term the fifth class kept individual diaries. They understood the purpose of the diary easily, and noted many details which most children would not remember. The diaries were examined once a week and individual instruction was given to the writer on his mistakes in grammar, spelling, etc.

It was not necessary to inflict corporal punishment at any time. Standing up in front of the school, staying in at recess, etc., proved sufficient. Strange to say, the pupils did not like to be sent home from school, a fact used to advantage in inflicting punishment.

In addition to the senior school, classes for small children were conducted by Mrs. Ella J. Johnston. This junior school was carried on between the dates given above for the session of the larger school. The enrollment was made up of six girls and five boys. Simple work, similar to that given in kindergarten classes, forms the basis of the work in the junior school. These classes are very valuable in preparing the children for entrance into the senior school and enabling them to take up their work to greater advantage than would otherwise be the case. Mr. Johnston's report comments upon the work of the junior school as follows:

The value of this preparatory course can be realized best by those who take up the child's instruction in the senior school. Last term one of the boys com-

ing to the junior school for the first time was so frightened that he cried lustily until one of his sisters stood beside him. He continued to do this for six weeks. At the end of that time he became interested, and it was hard to persuade him to go home at the end of the period. Without this experience in the junior school, the boy would have caused considerable trouble in the senior school, besides delaying his own advancement.

Sewing classes were also conducted for the larger girls by Mrs. Johnston, various practical stitches being taught. Useful articles, such as sewing bags, needlecases, and aprons were made, and interest was stimulated by the fact that the girls were allowed to keep the articles made.

ATTENDANCE AT SALEM INDIAN TRAINING SCHOOL, CHEMAWA, OREG.

Several native students from the Pribilof Islands are at the Salem Indian Training School at Chemawa, Oreg. None of the pupils returned to the islands, nor were any enrolled during the year; the list of pupils, therefore, remains the same as at the close of 1919.

PRIBILOF ISLANDS NATIVES AT SALEM INDIAN TRAINING SCHOOL, DEC. 31, 1920.

Fratls, Akalina ¹ -----	Resident of St. Paul Island.
Fratls, Ouliana-----	Do.
Stepetln, Nicolai-----	Do.
Stepetln, Vasilil-----	Do.
Lekanof, George-----	Resident of St. George Island.
Merculief, Laurence-----	Do.

Ouliana Fratis has completed a course of study at the school and has since been given the responsibilities of acting as matron in one of the buildings for the smaller girls. It is doubtful whether she or her mother will ever return to the Pribilof Islands.

On November 18, 1920, Agent Crompton made an official visit to Chemawa for the purpose of later making recommendations regarding the policy of sending natives from the Pribilof Islands to that school. The following is extracted from his report:

Rumors had reached the island that the natives who were at Chemawa were not receiving good care, that their food was not plentiful and was of poor quality, and that the sleeping quarters were poorly heated. At first but little attention was paid to these reports, but they became quite persistent and resulted in my request for authority to investigate the matter. In addition there was a question regarding the general policy of sending natives to the States for their schooling.

I arrived at Chemawa late in the evening of November 17, 1920, and spent the entire following day at the school.

The superintendent, Mr. Harwood Hall, showed me through the classrooms of the institution during the forenoon, and the remainder of the day was spent in the various workshops and other buildings.

During the day all of the Pribilof boys were separately questioned regarding their comforts and treatment. They were informed that my visit was for the purpose of hearing their grievances if they had any, but they were unanimous in praise of their treatment, and in addition seemed to have a strong "school spirit" of pride in the institution. The boys were told that if they ever had any real grievances the agents at the Pribilof Islands wished to know of them, but that they should not worry their parents by writing about petty matters. Though I observed closely, nothing seemed to indicate that they were not well cared for in all respects. The food was inspected and the dormitories seen, and all was on an equality with conditions in first-class boarding schools.

¹ Mother of Ouliana Fratis and employed at the school.

The question of sending natives from the Pribilofs to Chemawa, then, becomes one of policy rather than one of doubt regarding the care they might receive while there. In the writer's opinion it is not to the interest of the United States to send them to outside schools, and there is doubt that it adds to the ultimate happiness of the individuals. * * *

It is recommended that no more children be sent to the Chemawa school at the instigation of the Bureau.

SAVINGS ACCOUNTS.

Certain of the Pribilof Islands natives have personal funds in the custody of the United States Commissioner of Fisheries as trustee. These funds are still on deposit with the Washington Loan & Trust Co., Washington, D. C., and draw interest at 3 per cent per annum, calculated on monthly balances.

The condition of the account as a whole on December 31, 1920, is shown in the statement which follows:

Balance on hand Jan. 1, 1920	\$3,093.57
Interest earned from Jan. 1 to Dec. 31, 1920	89.92
	3,183.49
Withdrawn by natives during above period	343.62
	2,839.87
Balance on hand Dec. 31, 1920	2,839.87

An itemized statement of the account showing the individual balances of the natives is as follows:

PRIBILOF ISLANDS NATIVES' SAVINGS ACCOUNTS IN CUSTODY OF THE UNITED STATES COMMISSIONER OF FISHERIES, AS TRUSTEE, DEC. 31, 1920.

ST. PAUL ISLAND.			
Bourdukofsky, Apollon	\$90.42	Merculieff, Paul A	\$15.16
Bourdukofsky, Peter	60.70	Pankoff, Agrippina	235.60
Fratiss, Agrifina ¹	92.90	Pankoff, Maria M	43.13
Fratiss, Akalina ¹	547.73	Sedick, Feofania	13.47
Fratiss, Martha ¹	92.91	Sedick, Lavrenty	13.47
Fratiss, Ouliana ¹	92.91	Sedick, Leonty	13.47
Gromoff, Iuliana	348.70	Sedick, Marina	.38
Kozloff, Parascovia	7.28	Tetoff, Vikenty M	43.12
Krukoff, Ekaterina ²	197.91		
Krukoff, Iuleta	8.90	ST. GEORGE ISLAND.	
Mandregan, Alexandra M	10.23	Borenien, Zoya ³	235.97
Melovidov, Alfey	43.13	Galanin, Mary	155.75
Melovidov, Anton	3.70	Lestenkof, Michael	118.10
Melovidov, Iosef	43.13	Merculieff, Agrippina	64.54
Merculieff, Agafia ⁴	38.67	Merculieff, Joseph	24.28
Merculieff, Dosofey	38.67	Merculieff, Polyxenia	12.28
Merculieff, Makary	38.67	Shane, Michael	29.65
Merculieff, Mariamua ⁵	64.40	Zacharof, Emanuel	.45
		Total	2,839.87

PAYMENTS FOR TAKING SEALSKINS.

Following the plan of the two preceding seasons, funds for paying certain persons engaged in the sealing operations at the Pribilofs in 1920 were advanced by Funsten Bros. & Co., and the firm was

¹ Not living on islands in 1920.

² New account; formerly account of Alexey Emanoff, deceased.

³ New account; formerly account of Terenty Merculieff, deceased.

⁴ Includes \$24.98 transferred from account of Auxenia Diakanoff (Mrs. C. H. Hope).

⁵ Includes \$115.14 transferred from account of Mary Philemonoff, deceased. Zoya Borenien was formerly Zoya Philemonoff; now deceased and estate undivided.

duly reimbursed from the proceeds of the sale of the dressed and dyed skins. Under this arrangement the funds are deposited in a Seattle bank to the credit of the Bureau's authorized and bonded agent at the Pribilofs, who issues checks against the deposit covering accounts payable therefrom.

The practice of paying the island natives for their labor in taking commercial skins was continued. They were paid on the basis of 50 cents each for skins taken from seals up to and including the 6-year-old class, and \$1 each for skins taken from seals of 7 years and upward. No payments are made for labor in taking the skins of seals which are killed primarily for food.

During the calendar year 1920 and through January 31, 1921, the following payments were made from funds advanced by Funsten Bros. & Co.:

Salaries of sealing assistants, St. Paul Island.....	\$3,079. 49
Wages of Aleutian Islands natives at St. Paul Island.....	4, 275. 43
Amount earned by St. Paul natives, 1920.....	11, 112. 00
Amount earned by St. George Island natives, 1920.....	2, 127. 00

Total 20, 593. 92

In addition to the above total, the sum of \$645 was paid the natives of St. Paul Island during 1920, this amount representing an unpaid credit for the year 1919, which was entered as an undivided credit in the list of expenditures for that year.

Owing to the death of Peter Tetoff, one of the natives at St. Paul Island, there remains an unpaid balance of \$246.50 on account of the sealing work for 1920 on that island; this amount will be paid to the estate of the deceased when it is settled, thus closing the account.

St. Paul Island.—Of the 22,220 skins taken on St. Paul Island during the calendar year 1920, the native workmen received payment for 21,097 skins at the rate of 50 cents each and 710 skins at the rate of \$1 each; the other skins were from seals killed for food for which no payment was made. The fund was divided among the participating natives according to their ability, as follows:

DISBURSEMENTS TO ST. PAUL NATIVES FOR SEALING OPERATIONS, CALENDAR YEAR 1920.

Classification.	Number of men.	Share of each.	Total.	Classification.	Number of men.	Share of each.	Total.
First class.....	28	\$246. 50	\$6, 902. 00	Fifth class.....	3	\$99. 50	\$298. 50
Second class.....	13	197. 50	2, 567. 50	Additional compensation ¹			100. 00
Third class.....	7	160. 00	1, 120. 00	Total.....	54		11, 358. 50
Fourth class.....	3	123. 50	370. 50				

¹ Allowed 2 native foremen.

St. George Island.—Of the 4,428 skins taken on St. George Island during the calendar year 1920, 4,030 were paid for at the rate of 50 cents each and 12 at the rate of \$1 each; the balance of the year's take was composed of skins from seals killed for food for which no credit was allowed. The resulting fund was divided among the natives who took part in the operations according to the extent and

proficiency of their work. The division was made as shown in the following table:

DISBURSEMENTS TO ST. GEORGE NATIVES FOR SEALING OPERATIONS, CALENDAR YEAR 1920.

Classification.	Number of men.	Share of each.	Total.	Classification.	Number of men.	Share of each.	Total.
First class.....	14	\$110.00	\$1,540.00	Boys' class.....	3	\$10.00	\$30.00
Second class.....	3	79.00	237.00	Additional compensation ¹			100.00
Third class.....	1	62.50	62.50	Total.....	24		2,127.00
Fourth class.....	3	52.50	157.50				

¹ Allowed 2 native foremen.

PAYMENTS FOR TAKING FOX SKINS.

Following the plan of past seasons, natives at the Pribilofs were paid for their labor in taking fox skins during the winter of 1919-20 on the basis of \$5 for each skin secured. The funds are credited to each community as a whole and are later divided among the participating workmen according to the extent and skill of their work. On St. Paul Island 188 skins were taken, resulting in a total credit of \$940 to be divided among 43 men. On St. George Island 750 skins were obtained, making a total credit of \$3,750 to be divided among 30 men. These sums will be paid from the proceeds of the sale of the skins, in February of 1921.

CENSUS.

The usual annual census of native inhabitants of the Pribilof Islands was taken on March 31, 1920. The following recapitulation shows a total of 336 natives accredited to the two islands, 4 of whom are attending the Salem Indian Training School at Chemawa, Oreg. The census of 1920 gives the same number of resident inhabitants for St. Paul Island as were present on March 31, 1919. On St. George Island a gain of 6 inhabitants is shown in the number actually resident:

RECAPITULATION OF CENSUS OF NATIVES, MAR. 31, 1920.

St. Paul Island:	
Resident population Mar. 31, 1919.....	188
Births in year ended Mar. 31, 1920.....	9
	197
Arrivals in year.....	14
	211
Deaths in year.....	7
	204
Departures in year, permanent—To Blorka Island.....	3
	201

Departures in year, temporary—	
To Unalaska	11
To St. George Island	2
	13
Total native resident population Mar. 31, 1920	
Natives at Salem Indian Training School, Chemawa, Oreg	188
Others temporarily residing elsewhere	4
	14
Total natives accredited to St. Paul Island	
	206
St. George Island:	
Resident population Mar. 31, 1919	122
Births in year ended Mar. 31, 1920	8
	130
Arrivals in year (from St. Paul Island)	2
	132
Deaths in year	0
	132
Departures in year, permanent—To Seattle, Wash.	1
	131
Departures in year, temporary—	
To Chemawa, Oreg	1
To St. Paul Island	2
	3
Total native resident population Mar. 31, 1920	
Natives at Salem Indian Training School, Chemawa, Oreg	128
	2
Total natives accredited to St. George Island	
	130

FUR-SEAL HERD.

QUOTA FOR KILLING.

On May 26, 1920, the Bureau made recommendation to the Secretary of Commerce regarding the number of male seals which might be authorized for killing at the Pribilof Islands during the calendar year 1920. The Bureau's recommendation, approved by the Secretary May 26, 1920, was as follows:

QUOTA OF SEALS FOR KILLING IN 1920.

Age class.	St. Paul.	St. George.	Total.
3-year-olds.....	15,830	2,900	18,730
4-year-olds.....	4,400	1,100	5,500
7-year-olds and over.....	10,770	.....	10,770
Total.....	31,000	4,000	35,000

The foregoing figures are those which were given the Bureau's representatives at the Pribilofs for their general guidance. the numbers to be killed being subject to revision should conditions observed at the islands during the progress of operations indicate

the necessity therefor. As the season advanced it seemed wise to modify the original instructions, and accordingly, on July 22, the Acting Secretary of Commerce authorized the killing of 3,000 more seals of the 3-year-old class and 1,000 of the 4-year-old class. This was later modified to include only those seals of the 3-year-old class whose length was 43 inches or over. The instructions were conveyed by telegraph.

Killings of previous years having reduced the numbers of seals in the 5-year-old and 6-year-old classes of 1920 rather close to the reserve required by law, it was thought best not to draw further on these classes. A return to the desirable proportion of adult males to females is now reported on both islands, and upon the recommendation of the superintendent at St. Paul Island the killing from this class was stopped on July 23, after 703 skins had been secured.

KILLINGS OF SEALS.

St. Paul Island.—In a total of 54 drives during the period from January 22 to November 29, inclusive, 22,220 seals were secured on St. Paul Island during the calendar year 1920.

St. George Island.—The first drive was made on St. George Island on May 31 and the last on November 19; in a total of 35 drives, 4,428 seals were killed during the calendar year 1920.

The total number of seals killed on both islands during the calendar year was 26,648. Details regarding the killings are shown in the following tables:

SEAL KILLINGS ON PRIBILOF ISLANDS IN 1920.

ST. PAUL ISLAND.

Date.	Serial No. of drive.	Hauling ground.	Skins secured.	Date.	Serial No. of drive.	Hauling ground.	Skins secured.
Jan. 22	1	Sea Lion Rock.....	68	July 17	30	Morjovi and Vostochni....	1,344
Jan. 30	2	do.....	4	July 19	31	Reef and Gorbach.....	1,369
May 18	3	do.....	58	July 20	32	Zapadni, Little Zapadni, and Zapadni Reef.....	466
June 4	4	do.....	97				
June 11	5	Reef.....	225	July 21	33	Tolstoi, Lukanin, and Kitovi.....	251
Do....	6	Tolstoi.....	85				
June 14	7	Morjovi.....	417	July 23	34	Reef and Gorbach.....	697
Do....	8	Vostochni.....	41	July 27	35	Morjovi and Vostochni....	1,432
June 19	9	Zapadni.....	357	July 29	36	Gorbach.....	428
June 21	10	Reef.....	541	July 30	37	Reef.....	259
June 23	11	Morjovi and Vostochni....	574	Do....	38	Lukanin and Kitovi.....	89
June 24	12	Polovina.....	295	Aug. 2	39	Tolstoi.....	210
June 25	13	Tolstoi.....	242	Aug. 3	40	Zapadni, Little Zapadni, and Zapadni Reef.....	225
Do....	14	Lukanin.....	114				
June 26	15	Zapadni.....	394	Aug. 4	41	Morjovi and Vostochni....	406
June 28	16	Reef and Gorbach.....	1,127	Do....	42	Gorbach.....	257
June 30	17	Morjovi.....	536	Aug. 5	43	Polovina.....	323
Do....	18	Vostochni.....	496	Aug. 6	44	Tolstoi.....	70
July 1	19	Polovina.....	270	Do....	45	Lukanin and Kitovi.....	40
July 2	20	Tolstoi.....	315	Aug. 7	46	Zapadni.....	49
July 3	21	Reef and Gorbach.....	840	Aug. 8	47	Reef and Gorbach.....	101
July 5	22	Zapadni, Little Zapadni, and Zapadni Reef.....	421	Aug. 10	48	Polovina.....	143
				Do....	49	Morjovi and Vostochni....	257
July 7	23	Morjovi and Vostochni....	2,000	Oct. 23	50	Reef.....	175
July 9	24	Lukanin and Kitovi.....	99	Nov. 9	51	do.....	34
Do....	25	Tolstoi.....	399	Do....	52	Lukanin.....	23
July 10	26	Reef and Gorbach.....	1,333	Nov. 20	53	Reef.....	34
July 11	27	Zapadni, Little Zapadni, and Zapadni Reef.....	669	Nov. 29	54	Gorbach.....	18
July 14	28	Reef and Gorbach.....	1,181			Total.....	22,220
Do....	29	Tolstoi, Lukanin, and Kitovi.....	382				

SEAL KILLINGS ON PRIBILOF ISLANDS IN 1920—Continued.

ST. GEORGE ISLAND.

Date.	Serial No. of drive.	Hauling ground.	Skins secured.	Date.	Serial No. of drive.	Hauling ground.	Skins secured.
May 31	1	North.....	5	July 13	19	Zapadni.....	36
June 7	2	East Cliffs and Staraya Artil.	22	July 15	20	North and Staraya Artil..	206
June 9	3	North.....	26	July 17	21	East Reef.....	354
June 12	4	East Cliffs.....	20	July 19	22	North and Staraya Artil..	224
June 16	5	North, Staraya Artil, and East Cliffs.	131	July 22	23	East Reef and North.....	430
June 19	6	East Cliffs.....	11	July 24	24	North and Staraya Artil..	277
June 21	7	North and Staraya Artil..	100	July 26	25	East Reef.....	103
June 25	8	East Cliffs and North.....	58	July 29	26	North and Staraya Artil..	269
June 28	9	East Reef and North.....	117	July 31	27	East Reef.....	163
June 29	10	Zapadni.....	58	Aug. 2	28	North and Staraya Artil..	26
June 30	11	Staraya Artil.....	130	Aug. 9	29	East Reef and North.....	80
Do....	12	North.....	88	Aug. 30	30	do.....	104
July 3	13	East Reef.....	11	Oct. 20	31	East Cliffs and North.....	199
July 5	14	North.....	170	Oct. 23	32	do.....	53
July 6	15	Zapadni.....	37	Nov. 2	33	do.....	53
July 7	16	East Reef and North.....	175	Nov. 17	34	North and Staraya Artil..	69
July 10	17	North and Staraya Artil..	521	Nov. 19	35	East Cliffs.....	12
July 12	18	East Reef.....	90			Total.....	4,428

AGE CLASSES OF SEALS.

The present method of classifying seals of unknown age has been developed from experimental work conducted since the summer of 1912, when a large number of male and female pups of that season were branded with a permanent distinctive mark. A few of these animals have been killed in each season since 1912 and the body lengths—from tip of nose to root of tail—and other data have been recorded. On the basis of the growth attained by these seals in each of the several years, limits of carcass length have been adopted for each year of age, and seals are now classified in accordance with the position their respective carcass lengths occupy in the scale taken from the branded animals. The limits now in use are as follows:

AGE STANDARDS OF BODY LENGTHS OF SEALS.

Age.	Lengths of summer seals.	Lengths of fall seals.	Age.	Lengths of summer seals.	Lengths of fall seals.
	<i>Inches.</i>	<i>Inches.</i>		<i>Inches.</i>	<i>Inches.</i>
Yearlings.....	Up to 36. 75	Up to 38. 75	4-year olds.....	46 to 51. 75	48 to 53. 75
2-year olds.....	37 to 40. 75	39 to 42. 75	5-year olds.....	52 to 57. 75	54 to 59. 75
3-year olds.....	41 to 45. 75	43 to 47. 75	6-year olds.....	58 to 63. 75	60 to 65. 75

AGES OF SEALS KILLED ON PRIBILOF ISLANDS, CALENDAR YEAR 1920.

Age.	Summer (Jan. 1-Aug. 10), 1920.			Fall (Aug. 11-Dec. 31), 1920.			Grand total.
	St. Paul.	St. George.	Total.	St. Paul.	St. George.	Total.	
Yearlings.....	7		7				7
2-year olds.....	166	194	360	2	26	28	388
3-year olds.....	15,914	2,917	18,831	233	312	545	19,376
4-year olds.....	4,988	843	5,831	46	44	90	5,921
5-year olds.....	45	61	106	2	3	5	111
6-year olds.....	39	4	43				43
7-year olds and over.....	709	12	721	1		1	722
Cows ¹	68	11	79		1	1	80
Total.....	21,936	4,042	25,978	284	386	670	26,648

¹ The few cows reported above, about one-third of 1 per cent of the total take, were accidentally and unavoidably killed. Every possible effort is made to avoid the killing of cows, but persons familiar with conditions at the islands will readily appreciate that once in a great while a cow is killed.

BRANDED SEALS.

Fifteen 8-year-old male seals, bearing the brand placed upon them as pups in 1912, were killed during the calendar year 1920. Of this number six were taken on St. Paul Island and nine on St. George Island.

It is from the 1912 series of branded seals that the data were obtained from which the age classification standards now in use were developed. Observations have also been made as to the development and movements of female seals bearing the 1912 brand. It is believed that more dependable information has been obtained as a result of the branding done in 1912 than from any similar work done in the past.

The following table shows certain information secured from the animals killed this season:

RECORDS OF BRANDED 8-YEAR-OLD MALE FUR SEALS KILLED ON PRIBILOF ISLANDS, CALENDAR YEAR 1920.

Serial No. of skin.	Date of killing.	Island.	Carcass weight. ¹	Carcass length.	Green- skin weight.	Trade classification.
	1920		Pounds.	Inches.	Pounds.	
AP6828	June 28	St. Paul.....	282	59.50	15½	Wig.
AP6829	July 10	do.....	288	70.00	27	Do.
AP6830	July 14	do.....	309	72.75	50	Do.
AP6831	July 23	do.....	271	73.25	41	Do.
AP6885	Aug. 4	do.....	251	69.25	27	Do.
AP7380	Oct. 23	do.....	297	73.50	33	Do.
G6150	June 21	St. George.....	249	69.25	24	Do.
G6158	July 5	do.....	351	72.25	38	Do.
G6159	July 15	do.....	260	69.50	37	Do.
G6160	July 19	do.....	243	68.25	23	Do.
G6161	do.....	do.....	273	69.25	35	Do.
G6162	do.....	do.....	286	73.00	43	Do.
G6163	July 22	do.....	259	73.50	37	Do.
G6164	Aug. 9	do.....	322	75.50	32	Do.
G6165	do.....	do.....	252	72.00	42	Do.

¹ Seals were bled before being weighed.

The above table presents information comparable with that secured from the branded seals of 1912 killed in past years. These earlier

data may be obtained by reference to the Alaska fisheries and fur industries reports for the years since the branding was done.

In order to add to the data already secured, it is the purpose of the Bureau to kill some of these male seals in each of the years they may continue to exist, but to insure an adequate remainder for observation during that period it will probably be necessary to reduce the number to be killed to three or four animals in each season.

CENSUS.

Following the practice of previous years a census of the fur-seal herd was taken in the summer of 1920. Details are contained in the report, printed on pages 104 to 120, by Dr. G. Dallas Hanna, who has been in local charge of the census work for a series of years beginning in 1915. Edward C. Johnston, storekeeper on St. George Island, assisted in the actual census work in 1920 on both islands. The growth of the herd from year to year renders it increasingly difficult to enumerate the animals, but, on the other hand, the observations of each year add to the concrete information available as a basis of computation and enable the determination of relatively accurate percentages of loss for the different age classes.

The following is a comparative statement of the numerical strength of the various elements of the herd in the years 1912 to 1920, inclusive:

GENERAL COMPARISON OF RECENT CENSUSES OF THE SEAL HERD.

Class of seals.	1912	1913	1914	1915	1916	1917	1918	1919	1920
Harem bulls.....	1,358	1,403	1,559	2,151	3,500	4,850	5,344	5,158	4,066
Breeding cows.....	81,984	92,269	93,250	103,527	116,977	128,024	142,915	157,172	167,527
Surplus bulls.....					8,977	17,110	17,110	9,619	6,115
Idle bulls.....	113	105	172	673	2,632	2,706	2,444	2,239	1,161
Young bulls (chiefly 5-year-olds).....	199	259	1,658						
6-year-old males.....					11,167	15,397	13,755	8,991	4,153
5-year-old males.....				11,271	15,494	14,813	11,941	5,282	5,007
4-year-old males.....	100	2,000	9,939	15,848	15,427	16,631	7,114	5,747	5,667
3-year-old males.....	2,000	10,000	13,880	18,282	19,402	19,507	9,117	13,596	10,749
2-year-old males.....	11,000	15,000	17,422	23,990	24,169	26,815	30,159	33,081	39,111
Yearling males.....	13,000	20,000	23,068	30,307	33,645	38,013	41,595	46,444	51,074
2-year-old cows.....	11,000	15,000	17,422	23,990	24,245	26,917	30,415	33,287	39,480
Yearling cows.....	13,000	20,000	23,067	30,306	33,646	38,018	41,608	46,447	51,081
Pups.....	81,984	92,269	93,250	103,527	116,977	128,024	142,915	157,172	167,527
Total.....	215,738	258,305	294,687	363,872	417,281	468,692	496,432	524,235	552,715

SPECIMENS FOR SCIENTIFIC PURPOSES.

For use in the preparation of a natural history group at the American Museum of Natural History in New York, several specimens of fur seals were collected at the Pribilofs during 1920. Thirteen skins were furnished the museum, one from an adult bull and eight from pups, all found dead on St. Paul Island, and one from a pup found dead and three from cows unintentionally killed in the sealing work on St. George Island. The collection was appraised at \$29, which amount was paid by the museum and properly deposited in the United States Treasury.

FOXES.

The foxes on the Pribilof Islands have regularly been the source of considerable revenue to the United States. The animals run at large on both islands and call for scarcely any outlay of funds and comparatively little labor.

One of the paradoxical features of the fox life on these islands is that the larger island, with a greater abundance of seal meat and more accessible beaches, has constantly furnished a smaller number of skins than St. George Island. Immediate conditions can not be assigned as the reason for this peculiar difference because of the fact that the situation has remained the same over a period of more than 40 years. Methods of feeding adopted on St. George Island in more recent years have caused a still greater contrast in the size of the catches on the two islands.

In the assumption that the foxes obtain sufficient food from the seal bodies remaining on the killing fields and from the natural food on the seashore, no special effort to feed the animals is made on St. Paul Island. The foxes are trapped with common steel traps during a short season in the early winter. When possible it is always planned to do this trapping before the heavier snowfalls take place, so that the runways may be observed and the traps placed on the ground. The time for trapping is usually selected with respect to the condition of the ground surface and the outlook of the weather.

TRAPPING SEASON OF 1920-21.

During the trapping season of 1920-21 a total of 1,125 blue and 14 white fox skins was taken on the two islands. Of this number 123 blue and 13 white skins were taken on St. Paul Island and 1,002 blues and 1 white on St. George. In addition, there were reserved for breeding purposes on the latter island 242 male and 240 female foxes, making a grand total of 1,485 animals handled there during the winter. The above take is the largest since the winter of 1892-93 when 373 animals were caught on St. Paul Island and 928 on St. George; during that year no reservation of breeders was made, however. The gain in this season's take, as in several past, comes entirely from St. George Island where the herd has been growing rapidly for a number of years.

With respect to the methods in use at St. George Island, Agent C. E. Crompton has recently submitted a detailed report as follows:

METHODS EMPLOYED IN THE MANAGEMENT OF THE BLUE FOXES ON ST. GEORGE ISLAND, ALASKA.

The blue foxes of St. George Island, Alaska, are the stock of what is probably the most successful fox farm in the country at the present time, if not the most promising in the world. The history of the ebb and flow of fox life on that island and the relation of that fluctuation to the influences which man has directly or indirectly brought to bear form a very interesting nature study.

History states that the furs of the seals, sea otters, and foxes were much exploited during the years immediately following the Russian discovery of the island, but no authentic records prior to 1840 are available. James Judge states that during the 19 years ending with 1860 the average annual catch was over 1,200 animals; during the first 19 years of the American tenure of the island the average catch was approximately 1,000 each season. Trapping was conducted during but four of the six winters from 1890 to 1896, inclusive, and

with such poor results that a total of only 2,325 pelts was secured. These latter years mark the most important changes in the history of the herd.

During the years preceding 1896 the foxes had always been forced to seek their winter food from the summer's accumulation of fur-seal carcasses on the killing fields, and up to the year 1885 had probably secured an abundance of food therefrom. Coincident with the decline of the seal herd, however, and particularly during the *modus vivendi* of 1891-1893, which restricted the land killing of seals to 7,500 annually, pending the award of the Tribunal of Fur-Seal Arbitration at Paris, the number of foxes became rapidly smaller. The situation, however, was not immediately recognized as a shortage of food, the agents of the Government placing the blame on excessive trapping by the lessees.

The state of affairs was probably first seen in its true light by Treasury Agent James Judge, who, in the summer of 1896, prepared a quantity of surplus seal meat by lightly salting and storing the food in the manner of ensilage. The experiment was successful, and Mr. Judge immediately recognized the possibility of selective killing by catching the animals in box traps instead of the steel traps which had always been used theretofore. A trapping house, with a wire cage adjoining, was the final outcome of the above-described experiment. The foxes came readily to the cage to obtain the much-needed food and were caught when the cage door was closed by a rope leading from within the house.

The methods of trapping outlined in the following pages are based on the work of James Judge, to whom much credit is due. That his principle was right and that it has been properly carried out was shown by the catch of 1919-20, when 750 pelts were secured and 454 animals released as breeders: the largest number of skins obtained since 1892-93, and, with a single exception, the largest total of animals caught in any season since the inauguration of the present system.

Food.

The natural food of the blue fox of the Pribilof Islands is made up of birds, eggs, insects, berries, miscellaneous bits of animal matter cast up by the sea, and occasionally dead seals, sea lions, walruses, or whales. While such food is plentiful during the milder seasons, it is reduced to the single item of beach food during the winter, when the shore is at times in the grip of frozen spray for long periods. Drift ice also closes the beaches for days at a time and usually large deposits of ice are left stranded, and these hinder the foxes in their search for food. It is at once apparent that comparatively few animals would survive a severe winter without a reserve supply of food.

In ordinary seasons the foxes of St. George Island are dependent upon a reserve supply of seal meat as food from September 15 to April 30. These dates are very safe and they will, of course, vary as the seasons are mild or severe, early or late, but will in most instances mark the period of need. "Open" or unfrozen beaches during the winter time often furnish much additional food, and during such intervals the foxes feed but lightly on the seal meat. On the other hand, a protracted period of cold prevents the animals from obtaining the natural food of the seashore, and they then visit the feeding ground in large numbers, consuming surprising quantities of meat. This feeding is necessary by reason of the fact that there are on the island at the present time many more foxes than the comparatively small supply of natural food in the winter season can support, and the size and rate of growth of the herd are primarily limited by the number which can be sustained during that trying period.

Preparation of food.—Seal meat has been found to be a successful and most readily obtainable food for use as a reserve. The foxes use all the seal meat which is not consumed by the native inhabitants of the island. After a killing of seals has been made the natives cut up the carcasses, remove the choicest portions for their own immediate and future needs, and the surplus is stored for winter fox food. At a suitable time (usually the day following the killing) the carcasses are eviscerated and emptied of free blood clots to retard putrefaction. If large, the carcasses are cut into sections, but if the seals are of a size readily handled they may be stored whole. It is not a good practice to store the meat before it has cooled, nor should it be left on the field through a hot, sunny day.

The carcasses are deposited in a large pit or silo, which is cut into the side of a hill of hard, scoriaceous earth. The outer side of this pit is bulkheaded

with strong planks and a small doorway, closed by means of flashboards, is placed near the center of the base of the bulkhead. This door serves both as a drain for the effluent water and oil and as a port from which the meat may be drawn as needed.

As the meat is thrown into the pit it must be spread about evenly and sprinkled with a small amount of half-ground salt. Salt which has already served a part of its usefulness in the sealskin kenchies is entirely satisfactory for salting fox food. It is of great importance to have the meat spread in such a manner as to leave as little air space as possible; the principle is primarily that of ensiling rather than salting. It is surprising how well the meat will be preserved with but very little salt if the air is properly excluded.

After the summer's sealing has been completed the silo is covered with a sectional hatch, which rests on the edges of the pit. It is not of advantage to store the seal meat resulting from the fall killings, as the natives take large quantities for salting and freezing and the foxes will consume the fresh remains in a short time.

Before the feeding of the reserve food begins it should be freshened by the passage of fresh water through the pit. This is done by laying a pipe line to a siphon, which draws the water from a lake near by. The water should run at least two weeks steadily, but must not be turned on until the time for feeding draws near, else the food will begin to decompose unnecessarily.

Feeding.—Having decided that feeding should begin, a supply of the prepared meat is removed from the silo to the food kenchies in the trapping house, where it may be drawn upon with ease as required. The native foreman is then instructed to put out a small experimental amount in the neighborhood of the building and to report the following morning as to the quantity consumed. Upon receiving this report the agent will know how to proceed the following evening. It is a commendable practice to provide for a remainder of food each morning, except during the active trapping season, when the animals must not become satiated. The foreman details a single workman to the work of setting out the food for a week at a time, after which that man is relieved by some one who does the work for a similar period.

The feeding is continued in the neighborhood of the trapping building until two weeks or more before it is expected to begin trapping, at which time it is placed within the cage. Much smaller quantities of food are then put out, and it may be well, in the case of a mild season, to suspend feeding for a day or two, putting out only enough food to attract the animals to that vicinity. This must be decided and gauged by the manner in which the foxes have been feeding during the interval immediately preceding, and it is largely a matter of judgment.

When the beginning of trapping has been decided upon all waste bits of meat and bone are gathered together and stored in barrels in an inaccessible place, where they will not draw the foxes from the lure within the cage. After trapping has started, food is placed only within the cage and the accumulation of bones therein is cleaned out from time to time and disposed of as stated above. Bits of food which have been dragged outside the cage must not be allowed to accumulate, as the more timid foxes will feed on them in preference to entering the cage.

Trapping.

Season.—The season for trapping prime-furred foxes varies in direct relation to the degree and duration of cold weather. Ordinarily the best of the pelts will be secured between December 1 and February 1, though prime furs may be taken on either side of these extremes.

Toward the latter part of November a few foxes may be caught and the fur examined as to its marketable condition. The extent of growth of the guard or crown hairs is a very good guide, as when these hairs have reached a length extending well beyond the heavier fur the pelt takes on its well-known silkiness and luster so highly valued by the trade. The guard hairs are seldom, if ever, fully extended before the fur beneath has become prime. Many skins vary as to fur; some have a heavy growth of dark fur, while others may have comparatively thin coats of light color, but the primeness consists in a uniform growth of whatever class of fur the animal happens to have, accompanied by the full growth of guard hairs. Animals are occasionally seen with no visible growth of guard hairs, but these are presumed to be diseased and are so few in number as to be negligible.

During mild seasons it will be noted that some of the pelts have a decided reddish tinge to the guard hairs, and while the exact effect of this condition is not known to the writer, it appears that its presence is not of sufficient importance to warrant the cessation of trapping. In the two seasons of 1915-16 and 1919-20 this "rusty" condition was particularly noticeable, but on both of these occasions the furriers subsequently stated that the value of the skins was but slightly lessened thereby. While the darkest furs are the most desirable, a good pelt commands a fair price even though the reddish tinge is in evidence.

The approach of the end of the season and the lapse of primeness in the skins can not be determined by any rule. The condition of the fur must be carefully watched, for rubbed or felted patches about the throat or rump are a certain indication of unprimeness. The observations must naturally be made before the fox is killed.

Weather conditions.—There is probably no single indirect factor having a more important bearing on the outcome of the season's trapping than that of weather. Clear, cold nights, with moderate winds from points in the north or east, are the conditions under which trapping may best be conducted at the village. Western winds favor the Zapadni cage. High night tides are advantageous, low ones the contrary. While moonlight makes the trapping work easier, the animals may be seen without difficulty on the darkest night if there is a little snow on the ground. The lower the temperature and the longer the period of cold, the more favorable is the situation; the cold keeps the beaches frozen and the continuation of it forces the most timid animals to visit the cage in search of food. Storms do not necessarily preclude trapping if the winds are from favorable directions and are not exceedingly strong. Wet snow or rain is unfavorable, as the furs become wet and soiled on such occasions; this dampness is very undesirable when the skins are made ready for stretching. Trapping may, however, be conducted with fair results during mild weather when rain is not falling. Persistence is required if a large catch is to be made.

Location of traps.—Two cage traps are used at the present time, one at the village, the second at Zapadni. The advisability of installing a third is doubtful. The second trap was the natural outcome of the feeding of foxes at Zapadni and it is useful when winds are unfavorable for work at the village. The desirability of securing the largest number of pelts at the village trap is readily seen.

The village trap is the original building set up by James Judge shortly after his experiment of 1896, and, like all cage traps, it is near the shore line. The second is simply a wire cage set up in 1919 close by the Zapadni watch house. Efforts are occasionally made to secure foxes at Garden Cove (on the southern shore) by means of string or noose traps, but the results are quite disproportionate to the labor involved. It should also be mentioned that the foxes having their homes in the immediate vicinity of the village form a distinct colony, the members of which rarely visit the cage trap and must be obtained by noose traps placed within the village and operated from the windows of the village buildings.

Description of traps.—Herewith is a diagram showing the arrangement of the village trap. The drop door "F," sliding in a groove, is operated by a man stationed within the darkened room "B," who watches the animals through the small window "H," which commands a view of the trap interior. The Zapadni trap is on the same general plan, the cage standing apart from the house and being operated from the window. At Zapadni the foxes must be caught and removed from the trap by hand, while at the village it is much more readily done, as will be seen later.

The noose trap is a very simple arrangement. A small doorway is cut in the end of a common packing case, which is then placed with its open face to the ground, the door remaining open on the end of the case. Some bait having a strong odor, such as old seal meat or seal oil, is placed within the box, and a noose is hung about the doorway. As the fox endeavors to investigate the contents of the box, the noose is closed about his neck by an operator stationed within a near building. This trap is an unsatisfactory arrangement to use outside the precincts of the village, as when an animal is captured the resulting commotion frightens other foxes away from that neighborhood. Furthermore, but a single fox can be caught at each operation.

Operation of traps.—It must be borne in mind during the trapping season that the foxes are largely dependent upon the seal meat for their sustenance,

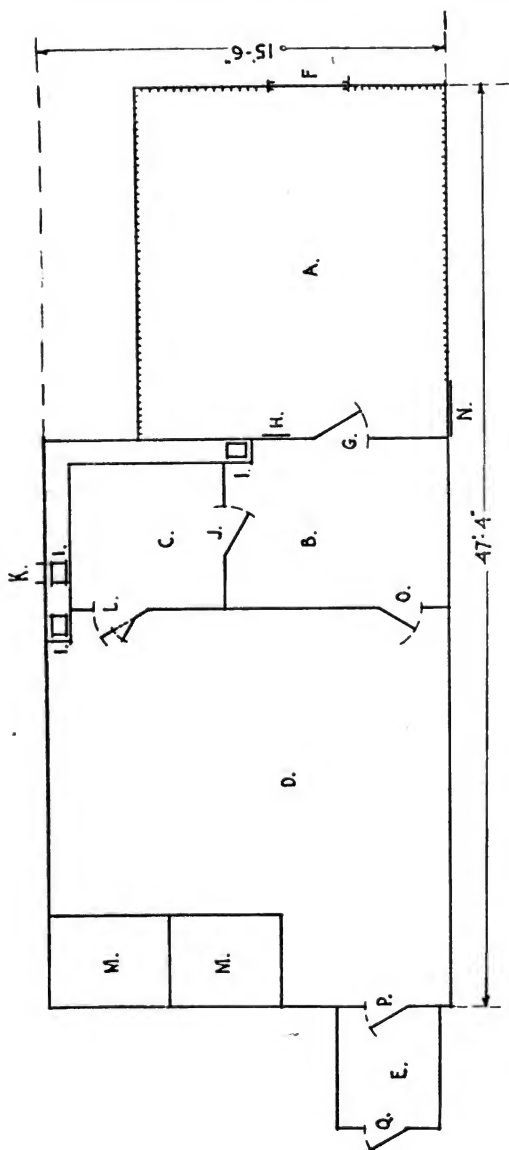


FIG. 1.—INTERIOR ARRANGEMENT OF FOX-TRAPPING HOUSE.

- A. Wire cage trap.
 B. Trapping room.
 C. Retaining room.
 D. Killing and skinning room.
 E. Vestibule.
 F. Sliding drop door.
 G. Trap outlet.
 H. Small window.
 I. Exits for releasing foxes.
 J. Door to retaining room.
 K. Final exit for released foxes.
 L. Special door to skinning room.
 M. Food kench.
 N. Food door.
 O. Door to trapping room.
 P. Entrance.
 Q. Storm door.

and, while large numbers of animals visit the cage in the morning after an evening's trapping, continuous operation of the trap over too long a period will cause the foxes to abandon their trips to the cage for food. Such a practice forces the foxes to search for food elsewhere and also prevents any record being made of those animals, either for their pelts or as breeders. The more timid foxes may be seen to wander about the trap for long periods before entering, and each time the trap is sprung these animals are frightened off. The writer believes that the trap should be left open to the foxes at least two full nights in seven, and if all-night trapping is practiced the feeding nights should be increased to three in each week. These precautions are not so necessary if the beaches are unfrozen.

The actual trapping of the foxes may be begun as early as 4.30 p. m. and continued as late as seems desirable. A responsible native, with an assistant, takes up his position in the trapping room opposite the small window and opens the sliding door by means of a rope. The opening of the door by the trapper exposes the food for the first time on any trapping night, so that no foxes will have previously satisfied their hunger. The trapper maintains a constant watch of the trap, and when several foxes are in the cage he lowers the door and imprisons them. This moment for dropping the door must be properly judged. There should be no foxes so near the door that they will be in danger of injury when it drops; the door should not be closed in the face of animals too near the trap, as they would only be unnecessarily frightened thereby; on stormy nights the door may be so carefully closed that even the foxes within the trap are not aware of the change. Only responsible natives should ever be left in charge of the trap rope; such men understand the foxes and do the work well.

After closing the trap the operator sends his assistant into the cage and the foxes are driven through the open doors "G" and "J" into the retaining room "C," where they are held until a sufficient number has been caught to warrant further attention. After closing the doors to the retaining and trapping rooms the cage door is raised and the operation is repeated.

Handling of animals.—It is not advisable to hold more than 20 foxes in the retaining room at one time, as the animals have a tendency to clamber about and will pile up and become overheated, particularly in mild weather. On the opening night of the season the foxes can be caught almost as rapidly as the skins can be handled, the trap taking as high as 10 or 12 in a single operation. Later in the season the more timid foxes appear and only 2 or 3 are taken at intervals of an hour or more.

When a suitable number of foxes has been caught, the skimmers and other men take up their places in the large room "D" and the work begins. Two or three men, armed with forked sticks, are sent into the retaining room, where they catch the foxes by pressing them down to the floor until a proper hold has been secured with the hands; the animal is grasped about the neck from behind. This work must be done with as much care as is consistent with a fair degree of speed, as some of the animals are to be reserved as future breeders and must not be injured by unnecessarily rough handling. If any marked breeders are found, they are liberated through the door "I" and the exit "K."

After catching the fox the native passes it through the opening in the special door "L," whereupon a man on the opposite side takes it from him, holding the animal in the same manner. Another man examines the fox and calls out its sex that it may be written down by the agent. The latter then examines the teeth by pushing back the lips or opening the jaws with a soft gag.

The weigher now places the fox's tail in the loop of a broad strap attached to a spring balance and the head of the fox is then carefully lowered so that the animal hangs to the scale by its tail. The fox must not be dropped into a hanging position, as the sudden snap might injure the bone or cartilage of the tail. The weight is then called out and the agent makes note of it; he then notifies the weigher whether the fox is to be killed or released. If to be released, the animal is marked and dropped through the door "I" and makes its escape through the exit "K." If to be killed, it is passed to another man (the fox is still held by the tail) who strikes it a smart blow on the head with a light club. After the fox has been stunned in this manner, its neck is broken by manipulation. The Skinner waits a few moments to make certain that the animal is dead, after which he removes the pelt while the body is yet warm.

Handling of Skins.

Skinning.—Fox skins are removed much in the same manner as those of most fur-bearing animals that are prepared for the market. The tail is split for a few inches on the lower side, the cut beginning at the anus; cuts are then made along the inner side of each hind leg, these incisions extending from the heel (the lower end of the metatarsal bones) to the anus. The pelt is first loosened around the base of the tail, the tail is then pulled from its sheath of skin, and the entire pelt is removed by pushing it loose from the fat and flesh with the fingers, a knife being used only about the head. After the skin has been loosened from the posterior part of the body it is simply everted over the head, so that the nose is the last part to be severed. The forelegs are pulled out of the skin without any cutting, except where a knife may be needed to separate the pelt from the tougher subcutaneous tissues.

While the skin is being drawn off there is some danger of tearing it or of forcing a finger through it, but such holes are usually the result of haste or carelessness. However, tears are sometimes made by the best of skinner, and in a large catch it may be difficult to secure perfect work throughout. Naturally, the pressure is always toward better workmanship.

After the skin has been entirely removed by the method outlined above, it is turned right side out and hung up on a peg or nail. When the work of the evening is over, the skins are counted, but are left in the trap building until ready for cleaning and stretching; the skins must be kept as cool as possible during this time.

During the first few killings of the season it is advisable to examine the flesh side of the skins, as the color found there is a good guide to the degree of primeness of the furs as a whole. The earliest skins may be found to be rather dark on the flesh side because of the roots of the growing hair and fur. This color fades as the season advances. While the writer has seen skins having what appeared to be fully prime pelage with the flesh side quite dark, it is not advisable to take any large number of skins during that part of the season when the bluish color on the flesh side of the skin is most pronounced.

The flesh side again darkens with the approach of unprimeness, but it has been observed on St. George Island that felted patches and rubbed spots are the first indication of the change. The fact that decision must be made before the fox is killed makes this a valuable point.

Cleaning.—The morning after the trapping the skins are taken to another building where the cleaning, stretching, and drying is done. The more skillful men sit in a row behind a beam which is placed in a horizontal position about 2 feet above the floor. A nail or peg is fixed in the beam opposite each man. The skin is turned flesh side out, the nose is placed over the peg and all the fat and flesh is removed with a very sharp skinning knife having a curved blade about 6 inches in length. The tail is split and all the fatty tissue removed from it; the forelegs can be cleaned without splitting. The work described here requires genuine skill with the knife.

After the pelt has been thus cleaned it is taken by one of the other workmen who turns the skin, rubs dry corn meal through the fur for the purpose of removing free grease or dampness, and then shakes it out. It is now turned again and searched for holes and if any are found they are sewed up. Small sticks are then inserted within the skin of the forelegs and bound in place; the tail is spread and bound round a larger stick and the skin is then ready for the stretching frame.

Stretching.—The stretching frame is a very simple arrangement of two light boards (1-inch material is usually used) put together on an acute angle, the length of the sides being in the neighborhood of 4 feet. The boards are joined edgewise, the nails of the joint being carefully toed; no third piece enters into the construction. After the joint has been secured, the boards are planed so that the edges form a smooth wedge with a rounded point. Properly made frames will last many years.

The skin is drawn on by inserting the smaller end of the frame in the opening across the hind legs and then slowly forcing it down the frame until the nose fits snugly. The entire surface of the pelt is then gently stretched downward with the palms of the workman's hands, and when it is well in place the hind legs are spread and bound to the sides of the frame in the manner shown in figure 3. The lips have been previously stitched together to prevent distortion of that part of the skin, and after the whole pelt has been well rubbed with corn meal it is set up for drying.

Drying.—The drying may be done in any large room where an even temperature can be maintained. It is always desirable to dry the skins slowly and with as little artificial heat as possible. The present method is to lay the frames in rows across light racks suspended from the ceiling at suitable intervals, the remainder of the frames being stood up about the walls. With the improvement of facilities this practice may be bettered.

After a lapse of from four to six days on the stretching frames the skins may be examined, and if dry all over, may be removed. The nose is one of the last parts of the skin to become fully dry. The skin should also be examined for excessive grease, and if any is found it must be removed with corn meal, for if it is left it will putrefy and weaken the skin. In taking the skin from the frame the hind and fore legs and tail are unbound and the skin gently started with the palms of the hands, after which it may be pulled off by the nose. When the skin has been removed from the frame a tag, bearing the date of capture, is tied into the mouth or eyeholes and the skin is hung up in the drying room for a few days, or until a sufficient number of pelts has accumulated for removal to the storage room.

Storing.—The two most important requirements for a storage room are dryness and darkness. The necessity for keeping the skins dry is apparent; the darkness is a safeguard against the fading of the fur, as the darkest furs command the highest prices. In storing the skins they are usually tied through the nose into clusters of 10 skins each, and these bunches are carefully tallied when stored. All the skins are again counted at the close of the season so as to verify the record of animals killed.

Shipping.—Fox skins are packed and shipped in boxes made of 1-inch boards of spruce or Douglas fir (spruce is preferable), with inside dimensions of 38 inches in length, 16 inches in width, and 12 inches in depth. The case is provided with a set of battens near each end, which lend rigidity to the whole and at the same time prevent any face of the box from coming into solid contact with a flat surface.

The packing of the skins is usually done within a day or two of the time shipment is to be made. The cases are lined with tarred building paper and reined with wrapping or newspaper as a protection against insects and dampness. The skins are carefully counted and laid flat in the case; unnecessary folding or creasing is to be avoided. The skins are shipped pelt side out. From 40 to 45 skins may be packed in a case such as the one described above.

After the proper number of skins has been packed in the box, the top is closed with the layers of paper and then the cover. The cover is nailed to the sides and ends of the case and to the battens on the sides. All cracks and holes are then closed by tacking on strips of galvanized iron or sheet zinc. The cases should be marked on both sides with the name and address of the consignee, the serial number and gross weight of the case, the number of skins it contains, and the legends, "Keep Away From Boiler Bulkheads" and "Keep Dry."

Disposition of Carcasses.

The disposition of fox carcasses is a matter of some importance. It is well known that foxes are, as a general rule, infested with parasites and intestinal worms of various kinds, and it should always be the effort of the agent to see that the carcasses of foxes killed are disposed of in such a manner as to prevent any possibility of infection from that source. The bodies of foxes found dead should be handled in a similar manner when practicable. The method now in use is that of putting the bodies into a covered pit, a practice both simple and effective.

Breeding Reserve.

Selection of animals.—The breeding foxes must be selected with care. The points of judgment are: (1) The condition of the teeth; (2) depth of color and condition of fur, short fur or white patches indicating an undesirable animal; and (3) weight, reserved males to weigh not less than 11 pounds and females not less than 8½ pounds. Cripples are always killed, though a short-tailed fox may be released if the animal appears to be a particularly desirable one from other points of judgment.

Since the beginning of the present method of handling foxes on St. George Island it has been constantly the purpose to eliminate the white foxes. That it has been partially successful is shown by the presence of only 4 white

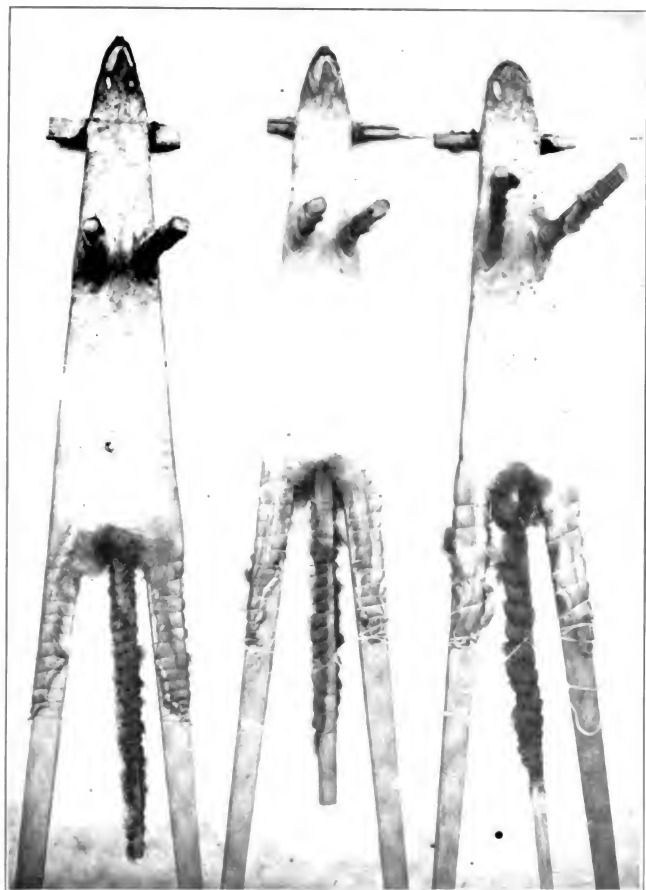


FIG. 2.—NATIVE METHOD OF STRETCHING AND DRYING BLUE FOX SKINS,
PRIBILOF ISLANDS, ALASKA.



skins in a catch of 750 taken during the season of 1919-20, as against 15 white pelts in a total of 486 secured in the season 1903-4. On St. Paul Island, where steel traps are being used and the selective killing is not carried on, 33 white animals appeared in a catch of 188 during the winter of 1919-20. The fight against white foxes on St. George Island has in recent years been extended against blue foxes which bear white marks of any kind.

After the selection of the breeder it is marked by clipping the fur of the tail and is then released. This mark is a notch near the tip of the tail in the case of a male and near the middle of the tail for a female. No such marked foxes are killed intentionally, and to avoid the possibility of such error it is a good plan to make the mark sufficiently plain to preclude any chance that the weigher may not notice it. Light marks made early in the season may grow to be almost indistinguishable before trapping stops.

The blue fox of St. George Island is monogamous, and because of this fact the sexes must be released in equal numbers when the reserve is made.

Size of reserve.—The amount of food available during the winter months is the factor which controls the size to which the herd may be allowed to grow. The release of 200 pairs of breeding animals for a number of years past has provided a steady supply of skins, but this number must be gradually increased in proportion to the food supply if a sound policy of growth is to be carried out. During the season of 1919-20 a reserve of 225 pairs was made with a view to such a growth, and it is intended that the reserve be further increased each season that the food situation will allow.

A consideration of the reserve naturally must bring in the factors of the number of young which reach maturity for each pair released and the percentage of natural mortality for all classes of foxes. It is to be deplored that we know little of these factors, except as light has been thrown upon them by the growth or decline of the herd. From the past rate of growth we may assume a given number of maturing young and a given death rate, both of which are subject to an unknown correction of animals not caught, but such figures are somewhat arbitrary and must be used with caution. We can not place dependence on the uncertain figure of the number of maturing young or the unknown reserve of animals not handled; the only reliable figures are those from known reserves, and it is upon these we must base our policy.

REINDEER.

In August of 1911, 40 reindeer were brought to the Pribilof Islands to determine whether these animals would thrive and eventually provide a source of fresh meat for the Government employees and natives stationed there. Twenty-one cows and 4 bulls were landed on St. Paul Island and 12 cows and 3 bulls on St. George Island.

The experiment has proved entirely successful. While the herds have become quite wild and difficult to handle through lack of time for attending them, fairly accurate counts at the close of the calendar year 1920 showed 192 deer on St. Paul Island and 125 on St. George Island. The herds are becoming regularly more valuable as a meat supply, the number used for this purpose being larger each year. On St. Paul Island 22 reindeer were killed for food during the calendar year 1920 and on St. George Island 31 were so used. In the previous year 14 on St. Paul and 22 on St. George were killed for food.

SHIPMENTS OF FUR-SEAL AND FOX SKINS FROM PRIBILOF ISLANDS IN 1920.

Fur-seal skins.—Three shipments of sealskins were made from the Pribilof Islands in the calendar year 1920. The first of these was made up of 900 skins in 47 casks from St. Paul Island and 412 skins in 11 casks from St. George Island, the number from the latter place being the entire remainder of the catch of 1919 on that island. The

shipment left the islands April 7 on the Bureau's tender *Eider*, was transferred to the Alaska Steamship Co.'s steamship *Victoria* at Unalaska on April 19 for shipment to Seattle, Wash., and left the latter place on April 27 for St. Louis by freight via Northern Pacific to Minnesota Transfer and Chicago, Burlington & Quincy, arriving at St. Louis May 20.

On June 22 the U. S. S. *Saturn* took the remainder of the 1919 skins from St. Paul Island; the shipment was made up of 37 casks containing 505 skins. The *Saturn* proceeded to Bremerton, Wash., from which place the skins were forwarded July 7 to St. Louis by the same route as the first shipment. They arrived at St. Louis July 26.

The third shipment consisted of 476 casks containing 21,929 skins from St. Paul Island and 24 casks containing 1,133 skins from St. George Island; all were skins of the 1920 take. The skins were placed on board the *Saturn* November 25 for transportation to Seattle, Wash., left that place December 6, and arrived at St. Louis December 15, having been shipped by freight via Northern Pacific to Billings, and Chicago, Burlington & Quincy to St. Louis. This shipment made remarkably good time between Seattle and St. Louis, arriving in a little less than nine days.

Thirteen specimen skins were also shipped during the year. Four of these were from St. George Island and nine from St. Paul Island. The skins were brought south on the *Saturn*, arrived at Seattle September 26, and were shipped from there by express to the American Museum of Natural History at New York City.

Fox skins.—A single shipment of fox skins was made during 1920. This shipment consisted of 4 cases containing 155 blue and 33 white fox skins from St. Paul Island and 18 cases containing 746 blue and 4 white skins from St. George Island, a total of 938 skins. These cases were shipped in the same manner as the first shipment of seal-skins as far as Seattle, via the Bureau's vessel *Eider* and the commercial steamer *Victoria*, and from Seattle to St. Louis by express, where they arrived May 3.

SALES OF FUR-SEAL SKINS.

Two sales of dressed, dyed, and machined fur-seal skins from the Pribilof Islands were held in St. Louis during the calendar year 1920. One was on February 2 and the other May 10, at which times 9,100 and 5,752 skins were sold at auction for totals of \$1,282,905 and \$424,166, respectively.

The highest price secured at the February sale was for a lot of 70 skins, which brought \$177 each; the average price obtained was \$140.97, an increase of nearly 55 per cent over the average price at the preceding sale in September, 1919. At the sale in May the maximum price was \$125 per skin on two lots of wigs, 50 skins in each lot. The average price for the May sale was \$73.74, showing a decrease of about 48 per cent as compared with the February sale.

The first two of the following tables show details regarding the prices secured for each lot of skins in the two sales; the third table is a summary showing prices obtained for the skins in the various trade classes, with the percentages which the number of the skins in these several classes bore to the totals in each sale.

SALES OF DRESSED, DYED, AND MACHINED PRIBILOF FUR-SEAL SKINS AT ST. LOUIS, 1920.

SALE OF 9,100 SKINS, ST. LOUIS, FEB. 2, 1920.

Lot No.	Number of skins.	Trade classification.	Price per skin.	Total for lot.	Lot No.	Number of skins.	Trade classification.	Price per skin.	Total for lot.
1	50	Wigs.....	\$152.00	\$7,600.00	73	70	Extra large; cut, scarred, etc.	\$127.00	\$8,890.00
2	50	do.....	157.00	7,850.00	74	70	do.....	129.00	9,030.00
3	50	do.....	155.00	7,750.00	75	70	do.....	130.00	9,100.00
4	50	do.....	157.00	7,850.00	76	80	Large.....	160.00	12,800.00
5	50	do.....	156.09	7,800.00	77	80	do.....	157.00	12,560.00
6	50	do.....	156.00	7,800.00	78	80	do.....	164.00	13,120.00
7	50	do.....	156.00	7,800.00	79	80	do.....	162.00	12,960.00
8	50	do.....	156.00	7,800.00	80	80	do.....	162.00	12,960.00
9	50	do.....	162.00	8,100.00	81	80	do.....	161.00	12,880.00
10	50	do.....	162.00	8,100.00	82	80	do.....	161.00	12,880.00
11	50	do.....	163.00	8,150.00	83	80	do.....	160.00	12,800.00
12	50	do.....	167.00	8,350.00	84	80	do.....	159.00	12,720.00
13	50	do.....	169.00	8,450.00	85	80	do.....	160.00	12,800.00
14	50	do.....	166.00	8,300.00	86	80	do.....	161.00	12,880.00
15	50	do.....	169.00	8,450.00	87	80	do.....	162.00	12,960.00
16	50	Wigs; cut, scarred, etc.	115.00	5,750.00	88	80	do.....	162.00	12,960.00
17	50	do.....	116.00	5,800.00	89	80	do.....	161.00	12,880.00
18	50	do.....	115.00	5,750.00	90	80	do.....	160.00	12,800.00
19	50	do.....	117.00	5,850.00	91	80	do.....	161.00	12,880.00
20	50	do.....	120.00	6,000.00	92	80	do.....	160.00	12,800.00
21	50	do.....	118.00	5,900.00	93	80	do.....	163.00	13,040.00
22	60	Extra extra large.....	167.00	10,020.00	94	80	do.....	165.00	13,200.00
23	60	do.....	170.00	10,200.00	95	80	Large; cut, scarred, etc.	116.00	9,280.00
24	60	do.....	167.00	10,020.00	96	80	do.....	118.00	9,440.00
25	60	do.....	166.00	9,960.00	97	80	do.....	116.00	9,280.00
26	60	do.....	163.00	9,780.00	98	80	do.....	116.00	9,280.00
27	60	do.....	171.00	10,260.00	99	80	do.....	125.00	10,000.00
28	60	do.....	172.00	10,320.00	100	80	do.....	115.00	9,200.00
29	60	do.....	170.00	10,200.00	101	80	do.....	116.00	9,280.00
30	60	do.....	170.00	10,200.00	102	80	do.....	119.00	9,520.00
31	60	do.....	171.00	10,260.00	103	90	Mediums.....	124.00	11,160.00
32	60	do.....	168.00	10,080.00	104	90	do.....	126.00	11,340.00
33	60	do.....	167.00	10,020.00	105	90	do.....	123.00	11,070.00
34	60	do.....	174.00	10,440.00	106	90	do.....	123.00	11,070.00
35	60	do.....	170.00	10,200.00	107	90	do.....	122.00	10,980.00
36	60	do.....	173.00	10,380.00	108	90	do.....	121.00	10,890.00
37	60	do.....	171.00	10,260.00	109	90	do.....	121.00	10,890.00
38	60	do.....	169.00	10,140.00	110	90	do.....	122.00	10,980.00
39	60	do.....	168.00	10,080.00	111	90	do.....	121.00	10,890.00
40	60	do.....	172.00	10,320.00	112	90	do.....	121.00	10,890.00
41	60	do.....	172.00	10,320.00	113	90	do.....	121.50	10,935.00
42	60	do.....	172.00	10,320.00	114	90	do.....	120.00	10,800.00
43	60	do.....	171.00	10,260.00	115	90	do.....	123.00	11,070.00
44	60	do.....	171.00	10,260.00	116	90	do.....	122.00	10,980.00
45	60	Extra extra large; cut, scarred, etc.	124.00	7,440.00	117	90	do.....	123.00	11,070.00
46	60	do.....	124.00	7,440.00	118	90	do.....	122.00	10,980.00
47	60	do.....	131.00	7,860.00	119	90	Mediums; cut, scarred, etc.	100.00	9,000.00
48	60	do.....	127.00	7,620.00	120	90	do.....	99.00	8,910.00
49	60	do.....	130.00	7,800.00	121	90	do.....	102.50	9,225.00
50	60	do.....	127.00	7,620.00	122	90	do.....	104.00	9,360.00
51	60	do.....	131.00	7,860.00	123	90	do.....	105.00	9,450.00
52	60	do.....	130.00	7,800.00	124	90	Small mediums.....	90.00	8,100.00
53	60	do.....	131.00	7,860.00	125	60	do.....	90.00	5,400.00
54	60	do.....	132.00	7,920.00	126	90	Small mediums; cut, scarred, etc.	70.00	6,300.00
55	70	Extra large.....	161.00	11,270.00	127	50	III wigs.....	71.00	3,550.00
56	70	do.....	169.00	11,830.00	128	50	do.....	71.00	3,550.00
57	70	do.....	173.00	12,110.00	129	60	III extra extra large.....	82.00	4,920.00
58	70	do.....	172.00	12,040.00	130	70	III-25 extra large, 45 large.....	64.00	4,480.00
59	70	do.....	170.00	11,900.00	131	60	III-50 mediums, 10 small mediums.....	57.00	3,420.00
60	70	do.....	174.00	12,180.00	132	20	IV-9 wigs, 3 extra extra large, 2 extra large, 2 large, 4 mediums.....	56.00	1,120.00
61	70	do.....	171.00	11,970.00					
62	70	do.....	171.00	12,110.00					
63	70	do.....	168.00	11,760.00					
64	70	do.....	169.00	11,830.00					
65	70	do.....	170.00	11,900.00					
66	70	do.....	168.00	11,760.00					
67	70	do.....	168.00	11,760.00					
68	70	do.....	168.50	11,795.00					
69	70	do.....	177.00	12,380.00					
70	70	Extra large; cut, scarred, etc.	134.00	9,380.00					
71	70	do.....	130.00	9,100.00	9,100				1,282,905.00
72	70	do.....	128.00	8,960.00					

SALES OF DRESSED, DYED, AND MACHINED PRINLOF FUR-SEAL SKINS AT ST. LOUIS, 1920—Continued.

SALE OF 5,752 SKINS, ST. LOUIS, MAY 10, 1920.

Lot No.	Number of skins.	Trade classification.	Price per skin.	Total for lot.	Lot No.	Number of skins.	Trade classification.	Price per skin.	Total for lot.
1	50	Wigs.....	\$125.00	\$6,250.00	49	80	Large.....	\$51.00	\$4,080.00
2	50	do.....	125.00	6,250.00	50	80	do.....	81.00	6,480.00
3	50	do.....	123.00	6,150.00	51	80	do.....	81.00	6,480.00
4	50	do.....	123.00	6,150.00	52	80	do.....	80.00	6,400.00
5	50	do.....	122.00	6,100.00	53	40	do.....	81.00	3,240.00
6	50	Wigs; cut, scarred, etc.....	79.00	3,950.00	54	80	Large; cut, scarred, etc.....	57.00	4,560.00
7	50	do.....	72.00	3,600.00	55	80	do.....	52.00	4,160.00
8	50	do.....	78.00	3,900.00	56	80	do.....	50.00	4,000.00
9	50	do.....	79.00	3,950.00	57	80	do.....	50.00	4,000.00
10	60	Extra extralarge.....	124.00	7,440.00	58	40	do.....	49.00	3,920.00
11	60	do.....	121.00	7,260.00	59	70	do.....	49.00	3,430.00
12	60	do.....	120.00	7,200.00	60	90	Mediums.....	71.00	6,390.00
13	60	do.....	117.00	7,020.00	61	90	do.....	68.00	6,120.00
14	60	do.....	113.00	6,780.00	62	90	do.....	65.00	5,850.00
15	60	do.....	114.00	6,840.00	63	90	do.....	66.00	5,940.00
16	60	do.....	112.00	6,720.00	64	90	do.....	63.00	5,670.00
17	60	do.....	112.00	6,720.00	65	90	do.....	65.00	5,850.00
18	60	do.....	111.00	6,660.00	66	90	do.....	64.00	5,760.00
19	60	do.....	115.00	6,900.00	67	90	do.....	66.00	5,940.00
20	60	Extra extralarge; cut, scarred, etc.....	90.00	5,400.00	68	90	Mediums; cut, scarred, etc.....	50.00	4,500.00
21	60	do.....	79.00	4,740.00	69	90	do.....	45.00	4,050.00
22	60	do.....	72.00	4,320.00	70	90	do.....	44.00	3,960.00
23	60	do.....	67.00	4,020.00	71	90	do.....	44.00	3,960.00
24	60	do.....	64.00	3,840.00	72	90	do.....	46.00	4,140.00
25	60	do.....	64.00	3,840.00	73	90	Small mediums.....	55.00	4,950.00
26	30	do.....	64.00	1,920.00	74	70	Small mediums; scarred, etc.....	39.00	2,730.00
27	70	Extra large.....	108.00	7,560.00	75	50	III Wigs.....	40.00	2,000.00
28	70	do.....	98.00	6,860.00	76	50	do.....	41.00	2,050.00
29	70	do.....	93.00	6,510.00	77	50	do.....	41.00	2,050.00
30	70	do.....	92.00	6,440.00	78	50	III Extra extra large.....	37.00	1,850.00
31	70	do.....	92.00	6,440.00	79	60	III Extra large.....	37.00	2,220.00
32	70	do.....	91.00	6,370.00	80	60	III Large.....	36.00	2,160.00
33	70	do.....	91.00	6,370.00	81	70	III Mediums.....	26.00	1,820.00
34	70	do.....	93.00	6,510.00	82	30	III Small mediums.....	19.00	570.00
35	70	do.....	93.00	6,510.00	83	50	IV Wigs.....	10.00	500.00
36	70	Extra large; cut, scarred, etc.....	65.00	4,550.00	84	50	IV—3 extra extra large, 19 extra large, 10 large, 10 mediums, 8 small mediums.....	21.00	1,050.00
37	70	do.....	60.00	4,200.00	87	12	Skins—4 extra large, 4 large, 3 mediums, 1 small medium.....	53.00	636.00
38	70	do.....	60.00	4,200.00					
39	70	do.....	59.00	4,130.00					
40	70	do.....	59.00	4,130.00					
41	80	Large.....	92.00	7,360.00					
42	80	do.....	86.00	6,880.00					
43	80	do.....	84.00	6,720.00					
44	80	do.....	85.00	6,840.00					
45	80	do.....	81.00	6,480.00					
46	80	do.....	82.00	6,560.00					
47	80	do.....	81.00	6,480.00					
48	80	do.....	81.00	6,480.00		5,752			424,160.00

COMPARATIVE VALUES BY GRADES AND SIZES, WITH PERCENTAGES EACH SIZE OF SEALSKINS SOLD IN 1920.

Classes and sales.	Grade.	Number.	High.	Low.	Average.	Total.	Total number.	Average.	Total price.	Percentage.
Wigs:										
Feb. 2...	I and II...	750	\$169.00	\$152.00	\$160.20	\$120,150.00	1,159	\$140.47	\$162,804.00	12.74
	Cut, etc.....	300	120.00	115.00	116.83	35,050.00				
	III.....	100	71.00	71.00	71.00	7,100.00				
	IV.....	9	56.00	56.00	56.00	504.00				
May 10...	I and II...	250	125.00	122.00	123.60	30,900.00	650	81.38	52,900.00	11.31
	Cut, etc.....	200	79.00	72.00	77.00	15,400.00				
	III.....	150	41.00	40.00	40.66	6,100.00				
	IV.....	50	10.00	10.00	10.00	500.00				

COMPARATIVE VALUES BY GRADES AND SIZES, WITH PERCENTAGES EACH SIZE OF SEALSKINS SOLD IN 1920—Continued.

Classes and sales.	Grade.	Number.	High.	Low.	Average.	Total.	Total number.	Average.	Total price.	Percentage.
Extra extra large:										
Feb. 2...	I and II... Cut, etc... III... IV...	1,380 600 60 2	\$174.00 132.00 82.00 56.00	\$166.66 124.00 82.00 56.00	\$169.91 128.70 82.00 56.00	\$234,480.00 77,220.00 4,920.00 168.00	2,043	\$155.06	\$316,788.00	22.45
May 10...	I and II... Cut, etc... III... IV...	600 390 50 3	124.00 90.00 37.00 21.00	111.00 64.00 37.00 21.00	115.90 72.00 37.00 21.00	60,540.00 28,080.00 1,830.00 63.00	1,043	95.43	99,533.00	18.14
Extra large:										
Feb. 2...	I and II... Cut, etc... III... IV...	1,050 420 25 2	177.00 134.00 64.00 56.00	161.00 127.00 64.00 56.00	170.10 129.67 64.00 56.00	178,605.00 54,460.00 1,600.00 112.00	1,497	156.83	234,777.00	16.45
May 10...	I and II... Cut, etc... III... IV... Odd skins.	630 350 60 19 4	108.00 65.00 37.00 21.00 53.00	91.00 59.00 37.00 21.00 53.00	94.55 60.60 37.00 21.00 53.00	59,570.00 21,210.00 2,220.00 399.00 212.00	1,063	78.06	83,611.00	18.48
Large:										
Feb. 2...	I and II... Cut, etc... III... IV...	1,520 640 45 2	165.00 125.00 64.00 56.00	157.00 115.00 64.00 56.00	161.11 117.63 64.00 56.00	244,880.00 75,280.00 2,880.00 112.00	2,207	146.42	323,152.00	24.25
May 10...	I and II... Cut, etc... III... IV... Odd skins.	1,000 470 60 10 4	92.00 57.00 36.00 21.00 53.00	80.00 49.00 36.00 21.00 53.00	82.71 51.21 36.00 21.00 53.00	82,680.00 24,070.00 2,160.00 210.00 212.00	1,544	70.80	109,332.00	26.85
Mediums:										
Feb. 2...	I and II... Cut, etc... III... IV...	1,440 450 50 4	126.00 105.00 57.00 56.00	121.00 99.00 57.00 56.00	122.22 102.10 57.00 56.00	175,965.00 45,945.00 2,850.00 224.00	1,944	115.75	225,014.00	21.36
May 10...	I and II... Cut, etc... III... IV... Odd skins.	720 450 70 10 3	71.00 66.00 26.00 21.00 53.00	63.00 44.00 26.00 21.00 53.00	64.00 45.80 26.00 21.00 53.00	47,520.00 20,610.00 1,820.00 210.00 159.00	1,253	56.12	70,319.00	21.77
Small mediums:										
Feb. 2...	I and II... Cut, etc... III... IV...	150 90 10 10	90.00 70.00 57.00 55.00	90.00 70.00 57.00 55.00	90.00 70.00 57.00 55.00	13,500.00 6,300.00 570.00 4,950.00	250	81.48	20,370.00	2.75
May 10...	I and II... Cut, etc... III... IV... Odd skin.	90 70 30 8 1	55.00 39.00 19.00 21.00 53.00	55.00 39.00 19.00 21.00 53.00	55.00 39.00 19.00 21.00 53.00	4,950.00 2,730.00 570.00 168.00 53.00	199	42.57	8,471.00	3.45
Feb. 2...							9,100	140.97	1,282,905.00	100.00
May 10...							5,752	73.74	424,166.00	100.00
Both sales							14,852	114.94	1,707,071.00	100.00

SUMMARY OF FUR-SEAL SKINS SHIPPED TO FUNSTEN BROS. & CO.

The table published in the report on the Alaska Fisheries and Fur Industries in 1919, stated that at the end of the calendar year 1919 there were on hand at St. Louis in all 47,615 fur-seal skins from the Pribilof Islands. Of these 43 were so-called food skins, taken during the close season ended August 24, 1917, and the remaining 47,572 were commercial skins taken after that date. A letter of February 17, 1921, from Funsten Bros. & Co., the Bureau's selling agents, stated that in unpacking the shipment received in November, 1919, one more skin was found than was reported shipped. This made the grand

total on hand January 1, 1920, 47,616 skins. The following table shows shipments received and sales of skins by the firm during the calendar year 1920:

SUMMARY OF PRIBILOF ISLANDS FUR-SEAL SKINS RECEIVED AND SOLD BY FUNSTEN BROS. & CO., ST. LOUIS, MO., AND BALANCES IN FIRM'S CUSTODY, CALENDAR YEAR 1920.

Receipts.			Sales.				Balances on hand.		
Date of shipment from Pribilofs.	Date of receipt by firm.	Number of skins.	Date of sale.	Number of skins.			Food skins. ¹	Commercial skins. ²	Total.
				Food skins. ¹	Commercial skins. ²	Total.			
			Jan. 20.....			31	43	47,573	47,616
			Feb. 2.....	31	9,100	9,100	12	47,573	47,585
Apr. 6.....	May 20.....	1,312					12	38,473	38,485
			May 10.....	12	5,740	5,752		30,785	30,797
June 22.....	July 30.....	505						34,045	34,045
Nov. 25.....	Dec. 15.....	23,062						34,550	34,559
								57,612	57,612

¹ Skins taken from seals killed for natives' food prior to the termination on Aug. 24, 1917, of the 5-year period of restricted killings provided by the act of Aug. 24, 1912.

² Skins taken subsequent to Aug. 24, 1917.

FUR-SEAL SKINS ON HAND DECEMBER 31, 1920.

As in the published report for the preceding calendar year, a statement as to the number of fur-seal skins handled during the year and the number on hand, both at the Pribilof Islands and at St. Louis, at the end of the calendar year 1920 is submitted as follows:

ST. LOUIS RECORD OF SEALSKINS.

On hand Jan. 1, 1920.....	47,616
Shipments received in 1920:	
May.....	1,312
July.....	505
December.....	23,062
Total.....	24,879
Sales during 1920:	
January ¹	31
February.....	9,100
May.....	5,752
Total.....	14,883
Balance on hand at St. Louis Dec. 31, 1920.....	57,612

PRIBILOF RECORD OF SEALSKINS.

On hand Jan. 1, 1920:	
St. Paul Island.....	1,405
St. George Island.....	412
Total.....	1,817

¹ The preceding report for 1919 gave the number on hand as 47,615, but when the shipment received November, 1919, was unpacked in 1920, one more skin was found than was reported shipped, thereby increasing the number on hand by 1.

² Funsten Bros. & Co. paid the Government at the rate of \$80 each for 31 sealskins, of which the firm reported 17 spoiled in work and 14 prepared for exhibition purposes.

Skins taken in 1920:

St. Paul Island.....	22,220	
St. George Island.....	4,428	26,648

Total.....		28,465
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Shipments during 1920:

St. Paul Island.....	23,334	
St. George Island.....	1,545	24,879

Balance on hand at Pribilofs Dec. 31, 1920.....		3,586
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Grand total on hand Dec. 31, 1920.....		61,198
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SALE OF FOX SKINS POSTPONED.

The 901 blue and 37 white fox skins taken at the Pribilofs in the winter 1919-20 were not sold during the year 1920, the condition of the fur market making it advisable to defer their sale.

PATROL OF NORTH PACIFIC OCEAN AND BERING SEA.

As in previous years, a patrol was maintained by the Coast Guard for the protection of the migrating fur-seal herd and the prevention of poaching in the vicinity of the Pribilof Islands. Numerous courtesies in the way of transportation of passengers, mail, and freight for the Bureau are also gratefully acknowledged. The following extracts from a statement prepared by the Coast Guard relate in detail the work performed during the year:

MEMORANDUM CONCERNING OPERATIONS OF THE COAST GUARD IN CONNECTION WITH PATROLLING THE NORTH PACIFIC OCEAN AND BERING SEA DURING THE SEASON OF 1920.

The North Pacific Ocean and Bering Sea patrol, commanded by Commander J. H. Brown, United States Coast Guard, for the season of 1920 was made by the Coast Guard cutters *Unalga*, *Algonquin*, *Bear*, and *Bothwell*. These vessels were actively engaged during the season on patrol and in such additional work as furnishing transportation to various persons, including natives, civil authorities, school-teachers, and destitutes; delivering United States mail, food, and supplies to isolated settlements; assisting distressed vessels; extending succor to persons in need; furnishing medical treatment to natives; and enforcing the laws.

The *Unalga*, in command of Lieut. Commander B. L. Brockway, left Seattle on April 28, 1920, for Unalaska. The cutter had on board seven passengers for transportation to various points in Alaska, four of whom were employees of the Bureau of Fisheries. On May 7 she arrived at Unalaska, where all passengers left the vessel. The medical officer attached to the *Unalga* inspected the town of Unalaska and found the health and sanitary conditions to be good.

On May 14 the *Unalga* left Unalaska on her first cruise in Alaskan waters. She proceeded to Unimak Pass, cruised along the southern shore of Unimak Island, then visited Davidson Bank, and traveled along the fishing banks as far east as Sannak Islands. During this trip no fishing vessels were sighted.

On June 18 she left Unalaska for a cruise in the vicinity of Sime Bank. The only vessel seen on this trip was the American schooner *Wacona*, to which mail was delivered and to the crew of which medical treatment was afforded. The cutter later left for the Pribilof Islands and cruised in that vicinity for more than a week, but found no vessels in need of assistance. Two more trips were made to the Pribilof Islands and Sime Bank and to other fishing banks in Bristol Bay as far east as Ugashik River. While on one of these cruises the American schooner *City of Papcote* was boarded and medical treatment given to some members of her crew.

On August 14 the commanding officer of the *Unalga*, while serving in the capacity of United States commissioner, acted as arbitrator in a labor dispute at the Wood River cannery of the Alaska Salmon Co. Through his efforts a reconciliation was effected and the men returned to work. * * * On August 18 the *Unalga* cruised over the fishing grounds off Hagemeister Island, but sighted no fishing vessels while on this trip.

On October 20 Mr. A. H. Proctor, superintendent, Pribilof Islands, and several natives, were transported to the northeast point of St. Paul Island to obtain a quantity of salted sealskins, the motor boat of the Bureau of Fisheries being disabled at the time. * * * On November 23 the cutter proceeded to Sand Point, where the medical officer vaccinated a number of persons. The vessel then left for Port Townsend and arrived there on December 1, 1920.

The *Algonquin*, in command of Lieut. Commander W. A. Wiley, left Port Townsend on April 30, 1920, on her cruise in Alaskan waters, and arrived at Hydar, Alaska, on May 4. Four days later she proceeded to Ketchikan, where she remained until the 20th, awaiting the arrival of supplies forwarded to her from Seattle. On May 20 she left Ketchikan and took up the seal patrol the following day. Two herds, containing about eight seals each, were sighted off Sitka in the evening. The cutter continued the patrol until May 24, when she was called to Yakutat to transport a badly wounded Indian to the nearest hospital. * * * A rumor that about 500 fur seals had wintered in the vicinity of Attu was investigated, with the result that the report was found to be erroneous.

On July 6 Lieut. Commander W. A. Wiley, having become ill, was forced to relinquish command of the *Algonquin*, whereupon Lieut. Commander W. T. Stromberg assumed command. Lieut. Commander Wiley was invalided home.

During the months of June, July, and August the *Algonquin* made a number of cruises in the vicinity of the Pribilof Islands and to other places. While on these cruises she carried United States mail, transported passengers, delivered supplies for the Bureau of Education and others, and afforded medical aid to the sick.

On September 11 the *Algonquin* left Unalaska for a cruise to Unimak Island. Among others taken aboard for transportation to various points was Warden J. N. Braun, Bureau of Fisheries, who desired passage to St. George Island. On her return trip to Unalaska the cutter afforded transportation to Mr. H. Silverstone, of the Bureau of Fisheries.

On September 27, in compliance with the request of Mr. A. H. Proctor, superintendent Pribilof Islands, a board was appointed to examine and report upon the machinery of the U. S. F. S. *Eider*. The board recommended that urgent repairs be made to the vessel.

On October 10 the *Algonquin*, with the cutter *Bear* in tow, the latter having become disabled, set a course for Seattle and arrived there on October 20. * * * Preparations being completed, the cutter left Seattle October 28 on her return to Bering Sea and arrived at Unalaska on November 5. * * * Her duties being completed, the *Algonquin* left Unalaska on November 12 for Seattle. On her return trip she stopped at Akutan, Lost Harbor, the canneries at Ikatan and King Cove, Unalaska Harbor, Valdez, Juneau, and other places. * * * On November 28 the *Algonquin* left Juneau and arrived at Seattle on December 2, 1920.

The *Bear*, in command of Lieut. Commander F. S. Van Boskerck, sailed from Seattle on May 8, 1920, for Alaskan waters. While en route the commanding officer became ill, which necessitated the vessel's stopping at Alert Bay, British Columbia, where he disembarked to await transportation to Seattle. The executive officer, Lieut. Commander C. G. Roemer, then assumed command. The cutter left Alert Bay on May 18 and arrived at Unalaska on May 27, where she delivered the United States mail.

On June 6 she left for a cruise to the Pribilof Islands. A number of natives were afforded transportation on this trip. Navigation, especially in the vicinity of Nome, was rendered extremely difficult, owing to the prevalence of ice. On June 13 Lieut. Commander F. S. Van Boskerck boarded the vessel at Nome and resumed command. The *Bear* left for a cruise to St. Lawrence Island on June 22, but owing to severe ice conditions, it was found impossible to make a landing, so she returned to Nome, arriving there on September 21. * * *

On October 10 the *Bear*, in tow of the *Algonquin*, left Unalaska. On October 19 the cutter *Snohomish* made contact with the vessels and relieved the *Algonquin* of the tow, arriving at Bremerton Navy Yard on October 23, 1920.

The *Bothwell*, as part of the Bering Sea patrol force, reported for duty at Unalaska on August 1, 1920. This cutter made cruises to Bogoslof Island, Akutan, False Pass, King Cove, Latouche, and other places. While on these cruises the *Bothwell* collected certain geographic information, made reconnaissances of harbors, and delivered United States mail. On September 8 the *Bothwell* left Latouche on her return trip and arrived at Seattle on September 14, 1920.

In his report on the Bering Sea patrol Commander J. H. Brown states that the fishing fleets were not operating during the season in accordance with their usual schedule, and because of this fact but few of these vessels were fallen in with. He further states that there were no fishing vessels operating on the Sannak and Davidson Banks and but few on Sline Bank.

SEALING PRIVILEGES ACCORDED ABORIGINES.

One thousand two hundred and eighty-five fur-seal skins were taken by Indians off the coast of Washington during the months of April, May, and June, 1920. These skins, together with two more taken in June, 1919, were properly authenticated through the cooperation of A. D. Dodge, superintendent of the U. S. Indian School at Neah Bay, Wash. These seals were taken by Indians of the Washington coast in accordance with the privilege granted by the North Pacific Sealing Convention of July 7, 1911, and the act of Congress approved August 24, 1912. Of the total of 1,287 skins, 656 were from male seals, 630 from females, and one from a seal whose sex was not recorded.

JAPANESE SEALSKINS DELIVERED TO THE UNITED STATES.

On January 17, 1921, the Bureau was advised that 56 fur-seal skins, constituting 10 per cent of the total number taken from the Japanese herd on Robben Island in the season of 1920, were ready for delivery to a representative of the United States. Under the convention of July 7, 1911, the United States receives a share of skins taken from the Japanese herd. Instructions were issued for the shipment of these skins, and they reached San Francisco April 15, being forwarded at once to the Bureau's agents at St. Louis, where they were received on April 26. They will be dressed, dyed, and machined in the usual manner and sold for the account of the Government.

FUR-SEAL CENSUS, PRIBILOF ISLANDS, 1920.

By G. DALLAS HANNA.

I landed at the Pribilof Islands on June 16, 1920, from the U. S. naval radio tender *Saturn* for the purpose of making a census of the Alaska fur-seal herd which resorts there to breed. In order to complete the work it was necessary at various times to travel from St. Paul Island to St. George Island and vice versa. This was effected through the courtesy of the commanding officers of the *Saturn*, the Coast Guard cutter *Algonquin*, and the Bureau of Fisheries vessel *Eider*, to all of whom my appreciation is extended.

The census was made possible through the active cooperation of the superintendent of the Pribilof Islands, A. H. Proctor, in furnishing material and labor on St. Paul Island when necessary. C. E. Crompton, agent and caretaker, did likewise on St. George Island. E. C. Johnston, storekeeper on St. George Island, ably assisted in the actual census work as much as possible.

The methods used in counting and computing the various classes as given below were similar to those which have been in use for several years and which were outlined in the report of the Alaska Fisheries and Fur Industries in 1918, page 116.

PUPS.

DISTRIBUTION OF PUPS IN 1920.

Rookery.	Date of counts.	Living pups.	Dead pups.	Total pups.	Pet cent dead.
ST. PAUL ISLAND.					
Klitoi.		3,718	46	13,764	1.32
Lukanin.		2,853	79	12,832	2.69
Gorbach.		9,970	281	10,251	2.74
Ardignen.		1,163	17	11,180	1.44
Reef.		23,048	590	23,638	2.50
Sivutch.		8,281	94	18,375	1.12
Lagoon.	Aug. 12	353	8	941	2.35
Tolstoi.		16,808	388	17,286	2.24
Zapadni.		16,091	368	16,999	2.24
Little Zapadni.		12,214	280	12,494	2.24
Zapadni Reef.	Aug. 12	525	7	532	1.32
Polovina.	Aug. 11	5,794	212	6,006	3.55
Polovina Cliffs.	do.	2,511	62	2,573	2.41
Little Polovina.		1,690	21	1,711	1.25
Morjovi.	Aug. 10	2,818	118	2,936	4.02
Vostochni.		31,708	1,149	32,857	3.50
Total.		139,555	3,720	143,275	2.60
ST. GEORGE ISLAND.					
North.		8,944	182	19,126	1.99
Staraya Artil.		5,781	163	15,914	2.74
Zapadni.	Aug. 4	804	13	907	1.43
South.	do.	98	1	99	1.01
East Reef.	Aug. 5	2,543	98	2,571	1.09
East Cliffs.		5,493	112	15,605	2.00
Total.		23,753	499	24,252	2.06
Total, both islands.		163,308	4,219	167,527	2.57

¹ Based on estimated average harem.

The chief object in the counting of pups is the determination of the average number of cows to each bull, or the average harem. Since birth is given to but one young each year it follows that the determination of the number of young will give the number of breeding females, and by dividing this by the number of harem bulls found earlier in the season the average harem is determined.

Obviously the greater the number of pups counted the greater the accuracy of the census as a whole. Up to and including 1916 it was possible to count this class on all of the rookeries. In 1917, however, the greatly increased number of bulls prevented pup counting until such a late date that breeding areas could not all be gone over. The increase in size of the herd has further complicated matters. While it is not physically impossible to make a complete pup count when bulls are present in no greater numbers than in 1920, still a much larger force of counters would be required for the work than has heretofore been available.

Since 1917 a comparatively small proportion of the pups has been counted. Rookeries have been chosen, however, which were believed to represent the herd as a whole with regard to growth. They have been, in the main, the smaller ones, in order to reduce to a minimum the danger of loss from trampling by bulls and from smothering.

Neither of these factors enters largely into the operations if a competent force of white men is performing the work, because there are expedients which can be used in emergencies which effectually prevent deaths. For instance, if pups have piled up in the counting and are in danger of smothering, they can be scattered by a man wading into the mass. There is no other known means whereby the animals can be spread out quickly enough to prevent loss on a warm day. It so happens that the natives are entirely too irresponsible to be depended upon in such an emergency. In seven years of counting I have never seen one offer to do the scattering in such an emergency. It is obviously impossible for the person who does the actual counting to keep constant watch of the "pod-ding" ahead of him, and if there should be no one else looking after that part of the work danger is sure to result; this is particularly true on the larger rookeries. Unfortunately the natives allowed eight pups to smother on Zapadni Reef rookery during the work on St. Paul in 1920. They have been included among the live pups on that rookery in the table because it is desirable to have the number of dead represent the natural loss only.

In selecting rookeries for counting in 1920 it seemed desirable in many ways to choose those which were counted in 1919. The working out of the average harem for those uncounted rookeries would then give results which were more strictly comparable than if new territory were selected.

While it seems reasonable to suppose that any one rookery would grow at the same rate as the herd, this is unfortunately far from the case. There is great variation among the several rookeries and on any one from year to year. This makes the estimating of the average harem on rookeries where pups have not been counted more or less uncertain. But unless all rookeries are counted—a manifestly impracticable task with a limited force and a large herd—no way to avoid the difficulty is known, and the matter must devolve upon the best judgment of those who have it in hand.

INCREASE OR DECREASE IN NUMBER OF PUPS IN 1920 FROM 1919.

Rookery.	Total pups, 1919.	Total pups, 1920.	Numerical increase.	Increase (+) or decrease (-).
ST. PAUL ISLAND.				
Kitovi.....	3,565	3,764	199	+ 5.58
Lukanin.....	2,788	2,932	144	+ 5.16
Gorbach.....	12,308	10,251	-2,057	-16.65
Ardiguen.....	1,150	1,180	30	+ 2.61
Reef.....	22,457	23,638	1,181	+ 5.25
Sivutch.....	7,015	8,375	1,360	+19.39
Lagoon.....	1445	1341	-104	-23.37
Toistol.....	16,027	17,286	1,259	+ 7.86
Zapadni.....	14,300	16,599	2,099	+14.58
Little Zapadni.....	10,145	12,494	2,349	+23.15
Zapadni Reef.....	1,604	1,532	-72	-11.32
Polovina.....	15,794	16,006	212	+ 1.36
Polovina Cliffs.....	12,209	12,573	364	+ 2.98
Little Polovina.....	1,203	1,711	508	+42.22
Morjovi.....	3,941	12,936	-105	- 3.45
Vostochni.....	30,963	32,857	1,994	+ 6.44
Total.....	133,914	143,275	9,361	+ 6.99
ST. GEORGE ISLAND.				
North.....	8,802	9,126	324	+ 3.68
Staraya Artil.....	15,746	5,944	198	+ 3.44
Zapadni.....	1,857	1,907	50	+ 5.33
South.....	168	199	31	+43.39
East Reef.....	12,367	12,571	204	+ 8.62
East Cliffs.....	5,418	5,605	187	+ 3.45
Total.....	23,258	24,252	994	+ 4.27
Total, both islands.....	157,172	167,527	10,355	+ 6.59

¹Pups counted.

It will be noted that upon some of the eight rookeries counted there has been no gain, whereas on others it has been considerable, and again that the gain on the lot has been only 3.77 per cent. This latter fact indicates very strongly that the gain of breeding cows has not been the 9 per cent which has been considered to be the normal rate.

It is true that the smaller rookeries do not increase as rapidly as the large ones, but there should not be this much discrepancy even though it is possible. It is entirely possible for the rookeries counted to have lost and the herd as a whole gain the normal amount, but it is not probable. The abnormal gain on the other rookeries would have been a noteworthy feature to a person who had had them in view during successive years. After a consideration of all of the factors which enter into the problem, the gains on the several rookeries have been estimated as shown in the above table. This, of course, is made up largely from the data on average harems (p. 116). It shows the gain of pups (and breeding cows) for the entire herd to be 6.59 per cent.

A noteworthy feature of the rookeries on which counts were made is the actual decrease in the number as well as the percentage of pups found dead in spite of an actual increase of total pups. This is entirely in accordance with predictions as to what would happen when the size of the harem would be increased. By using the figures of dead pups found on the various rookeries the numbers have been estimated for those which were not counted. This is shown in the table

above and illustrates the value of having a comparatively large average harem. The various proportions of massed areas where death rates are high to scattered rocky areas where they are low have been taken into consideration in arriving at the percentages. Also of prime importance in this connection is the fact that the size of the average harem in 1920 stands almost halfway between the figures for 1915 and 1916. It is reasonable to suppose that the percentage of dead pups would be governed thereby.

In the early days of pelagic sealing, when large numbers of dead pups were washed up by the surf, the impression was general that the animals were drowned by storms. The matter entered into international negotiations when it was maintained by the representatives of the Government of Great Britain that this was a prime cause of pup mortality. The fact that starvation was the cause of death as a result of the mothers having been killed by pelagic sealers was thereby concealed.

Dr. F. A. Lucas¹ has shown the subject in its true light and commented on the fallacy of the much-flaunted "deadly surf nip." By actual autopsy he demonstrated that the number of young animals drowned was insignificant.

I personally had never had an opportunity to make any observations on the subject until 1920, because violent storms had never occurred at the proper season during my seven years of work. But this year a heavy gale from the southwest drove an enormous surf into English Bay for three days during the latter part of July. It was precisely the time for deaths from drowning to occur, if such ever occur. Some pups are then dabbling in the edge of the water, while many others are young and weak.

After the storm thorough search of the entire stretch of English Bay beach was made, where over a thousand had been counted at one time during the days of pelagic sealing, but only 17 dead pups were found there. Not one of these 17 animals had drowned, and the majority of them were in an advanced stage of decomposition. They were simply some of the usual dead which had been washed off the rookery.

Thus the findings of Dr. Lucas in this respect are completely confirmed. Drowning is the cause of a very insignificant portion of the loss of fur seals.

The intestinal parasite *Uncinaria* may be present among the pups and may cause a few of the deaths recorded from year to year. Autopsies were made in a few cases in 1920 where decomposition had not proceeded too far, but in no instance could death be attributed to this cause. It may be that the parasite is epidemic at periodical intervals and will recur some time in the future. It is a point well worth keeping in mind by future investigators.

In 1915 the presence of a considerable number of animals, both young and adult, was noted and recorded which had the mange or some skin affection allied to it to a greater or less degree. Each year a few cases are seen, and they are usually marked by the presence of small, round, hairless spots. These are known in the fur trade by

¹ Fur Seal Investigations, 1896-97, pt. 3, pp. 83-84.

the erroneous term "rubbed spots." These are usually on portions of the anatomy which could not be "rubbed" under any circumstances. The number of cases of this disease gradually decreased to a minimum by 1917, which remained constant through 1920.

Ectoparasites of the fur seal are very rare, although the enormous amount of scratching which is visible in any "pod" would leave the casual observer with the impression that the opposite is the truth. In 1899 a louse, *Hæmatopinus callorhini* Osborn, was described from "a number of examples from the northern fur seal." And at the same time a tick, *Ixodes arcticus* Osborn, was described from a single individual.¹ I have made repeated search for these parasites, and several years ago located the louse on pups. Not all are afflicted by any means, but occasionally a few specimens can be secured from the eyelids and less often in the fur of the head. No positive information regarding the tick could be secured. A reward of \$1 per louse and \$5 per tick has been offered to the native workmen who kill and skin some 25,000 animals each year, but there have been only negative results. This leads me to believe that the louse is almost, if not wholly, confined to the pups, and very serious doubt is cast upon the *Ixodes arcticus* being a parasite of the fur seal at all.

COWS.

The number of breeding cows in the herd corresponds to the number of pups, since the one is derived directly from the other. There naturally exists in any year an excess of adult females over young, because there are always a few barren animals. The number, however, has never been considered other than inconsequential and is very properly ignored. The increase or decrease, in fact the existence of the species, is dependent upon the fertile cow; the others in no known way enter into commercial operations of man.

Formerly it was supposed that the cows which resorted to the hauling grounds with the bachelors were barren, but this is not the case at all. Thirteen cows which had been accidentally killed on the fields during the past four years have been examined and only one was found barren. Several of them had already given birth to young, but others had not, while the majority were 2-year-olds with reproductive organs normal in every way.

LOSS OF COWS ON THE ISLANDS.

The spreading of the bulls incident to the larger average harem produced a noticeable decrease in the death rate of cows on the breeding grounds. Since much of the turmoil and fighting of the past three years was thus done away with, such a result would be naturally expected. During the counting of 15,965 pups 9 dead cows were found. This is a percentage of 0.000563, which applied to the entire herd gives 94 as the total number. Comparable figures for preceding years were: 195 in 1919, 213 in 1918, 129 in 1917, and 39 in 1916. It shows that in spite of the increase in the herd there

¹ Fur Seal Investigations, 1896-97, pt. 3, p. 553.

has been an actual decrease in the number of dead cows, and it constitutes, along with the low death rate of pups, the strongest argument in favor of a reasonably large harem.

In addition to the decrease in number of dead cows found, there was a very noticeable decrease in the number of those which had been bitten and torn by the bulls. In no instance was an injury seen which was believed to be serious.

The closing of commercial operations on July 31 instead of August 10 is even more necessary now than heretofore, and it is again urged that this action be delayed no longer. It is well known that up to 1910 the Government prohibited the leasing companies almost every year from conducting sealing after July 31 on account of the number of cows which would otherwise be driven and unavoidably killed. This was a very efficient and sensible regulation and should by all means be inaugurated in the work of the Government.

During the commercial operations of 1917, 1918, and 1919 it has been pointed out many times that the resorting of the cows to the hauling grounds of the bachelors after August 1 interfered considerably with the work and caused the death of some of them. This flocking of the females to the hauling grounds is due chiefly to the fact that the breeding season has passed and they are free to move wherever they will. When bulls were abundant to replace each other on the rookeries, they held the cows longer in the harems. But the increase in the average harem in 1920 gave the cows a great deal more freedom than they had had for three years. This was evidenced by their flocking to the hauling grounds in greatly increased numbers. It was no uncommon thing on St. Paul for 250 cows to come up in a single drive after August 1. And on St. George they were so abundant that work was very seriously hampered. Naturally some of them were killed; not a large number, to be sure, but it is impossible to conduct the killing with reasonable dispatch so that all will be spared. Some accidents are unavoidable, because the 3-year-olds of both sexes are almost indistinguishable even to the practiced eye. The native workmen are ashamed of the work and unless importuned will not report the killing of a cow.

We may grant that the number of females killed by the extension of the season to August 10 is insignificant. Their value to the herd may not be as great as the increased revenue secured by the additional take of males; a simple calculation will demonstrate that. But the driving of these several thousand mothers, heavy with milk, is very inhumane to say the least. And if we may judge by the effect of similar exertion upon domestic animals permanent injury in many cases results. The long drives particularly tire them to the point of exhaustion, sometimes even to death. In dry weather the skin is worn from the flippers and leaves them raw or bleeding. All of these details are better left untold, but are given in hopes that the real importance of the situation will become apparent and that 1921 will see no driving permitted after July 31. We all of course know that it is not necessary to drive after that date in order to reduce the excess number of males satisfactorily. Forty years of commercial work has demonstrated that point.

LOSS OF COWS AT SEA.

It has been ascertained several times the past few years that the loss of cows at sea the first three years is approximately 50 per cent of all of those born. No data have come to hand which call for a revision of this result. It is an enormous death toll, and though it is almost certainly due to the work of some pelagic enemy, we know very little of it. Killer whales are known to devour the animals and are suspected of being their only enemy, yet proof is not to be had. Bryant has recorded the taking of 18 and 24 fur-seal pups, respectively, from the stomachs of two killers—\$2,000 meals, each of them. The investigation of this matter is one of the important tasks for the future. There are few studies which promise such fruitful results as would attend the successful solving of this problem. The protection afforded the cows and the consequent increased rate of growth of this class would be the permanent and most important benefit to the species and to man.

Actual figures as to the number of fur seals killed at sea under the treaty provisions allowing aborigines to hunt them are not yet available to me. Dispatches in the daily press, however, indicate that they are assuming proportions little short of alarming.

The proportions of the sexes taken in this pelagic catch are not known, but there is good reason to suppose that it consists largely of females. For the sake of convenience it may be assumed that 2,000 females were killed altogether on all coasts. This would reduce the Pribilof herd by double the number, or 4,000 in 1920, because the unborn pup is destroyed with the mother. In other words, the mainstay class of the herd has been reduced in a single season by over 1 per cent.

This matter is called to attention in the hope that a beginning may be made in solving the difficulty. Rather than have cows slaughtered it would be far preferable, if skins the Indians must have, to do as we have with Great Britain and Japan, give them an equivalent number of males from the land catch.

BRANDED ANIMALS.

Cows bearing the inverted T brand of 1912 on the top of the head were, as usual, in evidence on many of the rookeries. At Lukanin on St. Paul Island one was noted which was not believed to have been many hours out of the water. Two days later she had given birth to her pup but was located in a harem two bulls removed from where she was first seen. She was then seen each day until the eighth after her arrival. She could not be located later on the rookery, although she must have returned to nurse her pup. This confirms almost exactly a record made by W. I. Lembkey on the same rookery in 1902.

Further information was gained regarding those branded animals which may be conveniently classed as the 1902 series. A close study of them was begun in 1918 and the subject is dealt with at some length in the Alaska report for that year, pages 121 and 122.

The brands of this series consisted of one or more bars burned across the back or in a few cases with a longitudinal bar on the side combined with a cross bar. The work had for its object at the time of its inception the depreciation of the skin of the female to such an extent that it would be unprofitable for pelagic hunters to take it. The first experimental brands were put on in 1896, and when the operation was found to be practicable it was continued each season thereafter until 1902 on St. Paul Island and to 1903 on St. George Island, when it was abandoned. W. I. Lembkey states¹ that it was stopped in 1903 by departmental order. It was found a useless procedure in so far as the original objective was concerned.

A table was published in the 1918 report, page 122, which showed the totals branded each year on St. Paul. It included St. George also for 1896 and 1897. Subsequent records for the latter island could not then be located. Mr. C. E. Crompton has since found some of them and has kindly furnished them to me for use in this report. His records show the brandings on the smaller island for 1901 to 1903, inclusive, and they are embodied in the tables given below. Thus we now have the complete record of this work in so far as the island journals are kept, except for St. George Island, for the three years 1898, 1899, and 1900.

The records secured by Mr. Crompton failed to include one for October 12, 1903, of which I find a published statement in Appendix A to Hearings before House Committee on Expenditures in the Department of Commerce, page 100. It is there stated by Chichester that 274 pups were branded on that date. These have been added to the St. George totals for that year.

FEMALE PUPS BRANDED 1896 TO 1903.

Year.	St. Paul Island.	St. George Island.	Total.
1896.....	1,315	162	377
1897.....	² 5,371	³ 1,880	7,251
1898.....	2,363	(⁴)	2,363
1899.....	2,191	(⁴)	2,191
1900.....	1,698	(⁴)	1,698
1901.....	4,173	686	4,859
1902.....	1,416	1,326	2,742
1903.....	(⁴)	1,352	1,352
Total.....	17,527	5,306	22,833

¹ Jordan and Clark, Fur Seal Investigations, 1896-97, p. 326.

² Murray, *ibid.*, pp. 337, 338.

³ Judge, *ibid.*, p. 338.

⁴ No record.

It seems desirable to record here the character of brands used when it has been possible to ascertain them. During several years when branding was done, a few cows were also captured and received the mark, but the number was so insignificant as to need no further mention in this connection.

¹ Appendix A, Hearings House Committee on Expenditures, Department of Commerce, p. 388. 1911.

FEMALE PUP FUR SEALS BRANDED ON ST. PAUL AND ST. GEORGE ISLANDS.
1896 TO 1903.

Year.	Unknown. ¹	Single bar. —	Double bar. =	Triple bar. ≡	Quadruple bar. ≡≡	Triple crossbar. ≡≡≡	Single diag- onal bar. /
1896.....		191	² 2	62	³ 9	124	
1897.....		⁴ 5,389	⁴ 1,133	847			
1898.....		2,029					34
1899.....		2,191					
1900.....	⁵ 1,076	629					
1901.....	⁶ 4,888						
1902.....	2,245	497					
1903.....	² 1,370						

¹ Believed to have been single bar across back.² All cows.³ Includes 18 cows.⁴ Includes 100 cows.⁵ Includes 7 cows.⁶ Includes 29 cows.

Many records of "branding" after 1903 have been made, but they refer in every case, it is believed, to the marking of a bachelor reserve. This was first undertaken in 1904 and continued up to and including 1911. In every case, with the possible exception of the first year and irregular branding on St. George from time to time, permanent brands were not used. The hair was simply clipped from a spot on the back of the head so as to make the animal recognizable the remainder of that season. Unfortunately this process has been called "branding" almost always and has so confused the record of the real hot-iron work that the truth is in some cases in doubt.

A journal entry on September 25, 1901, was found which stated " * * * one [cow was seen] with a brand just behind its front flippers and another running parallel to its backbone, but a little to one side." In commenting upon this, C. E. Crompton says: "I positively saw [a cow with] this same brand at Staraya Artil while counting pups this year [1919]."

No record of the use of this brand has been found, but it was probably in 1898, or else no record was made when the work was done. Unfortunately the journal entries are usually very brief and do not describe the character of mark at all. As, for instance, "October 10, 1901; branded seals at Little East, 127 branded."

To have been a cow in 1901, the animal must have been born in 1898 or earlier. It is not likely that the odd brand was used on more than one batch of pups, nor in more than one year. This would make the cow seen by Mr. Crompton in 1919 at least 21 years of age. This is three years more than the maximum age which has heretofore been ascribed to a fur seal.

In all, seven cows of the 1902 series were seen on the various rookeries in 1920. Facilities for observation over the great mass of rookery areas are so poor, however, that this can represent but a small fraction of the number which must have actually been in existence.

It is most important to note that these animals were 18 years old, unless by possible chance they were all from the lot branded on St. George in 1903, when they would be 17. This is so highly improbable that it may be dismissed. Thus the maximum age of the cow is several years more than the most sanguine have previously suspected.

This leads to interesting speculation upon the comparative mortality of the sexes. But it will be sufficient here to dismiss the subject with the observation that no record is known to me of any individual bull having returned to the rookeries for more than three successive years. It is believed, however, that in the majority of cases they do return for at least five years.

Undoubtedly a mistake was made once in the branding in sorting the sexes, and a male pup got the mark across his back. He developed and occupied the same position on East Cliffs Rookery for three successive years, 1913, 1914, and 1915. In his last year he had to be at least 12 years old.

BULLS.

HAREM AND IDLE BULLS.

At the height of the breeding season the bulls which had harems and those usually termed idle were counted with the greatest possible accuracy. Steps have already been taken to adopt certain rookery improvements whereby this important count can be continued in the future, regardless of how large the herd becomes. Experiments with a stable skeleton tripod in 1920 demonstrated the superiority of such a structure over any form of elevating apparatus previously tried. The manner in which this was used is shown in figure 3.

By placing such a tripod near the beach line and having a skeleton walkway leading to it over the seals, a cheap and very effective means of counting large flat areas will be provided. It is expected that this will be tried out thoroughly in 1921. A few permanent markers on the breeding areas to divide them into sections should enable the enumerator to have absolute confidence in his result.

On account of the absence of some trustworthy manner to get up high enough to view the rookeries the harem counts since 1917, when bulls became very abundant, have not been as good on the large rookeries as desired. Many expedients have been used to help, such as counting from a boat, erecting markers of driftwood, climbing a long ladder, as well as natural elevations, which are sometimes reached with great danger; but all were more or less makeshifts, which it is planned shall be abandoned.

Although there doubtless is an error in the number of harems given for the larger rookeries, it is really very small and is conservatively estimated to be not greater than one-half of 1 per cent. The desirability of having even this small variation corrected is due to the fact that this is the basis of the census. A small error here will multiply throughout the computations.

The decrease in the number of bulls from 1919 was apparent not only in the records; on the rookeries it was very much safer to approach counting points, and disturbance of even the rear harems rarely resulted. There appeared to be a general "loosening up" of the compact areas maintained when the bulls were stationed closer together, so that the increase of area over 1919 appeared to be more than the figures indicated had been the increase in cows.

If it is possible to do so in the future, the counting dates on St. George Island should be set back to correspond with the beginning of the count on St. Paul Island. It has heretofore been customary to

make it after the St. Paul count, when one person was obliged to do both; and in 1920 it was thought best to continue the usual dates. However, if there is some one on the smaller island to whom the work can be delegated, it should be done. It was quite evident that harems had begun to break up, and some of the bulls which had completed their duties had resorted to the hauling grounds and elsewhere before the count was finished. Their places had been filled, of course, but it is better that the count be made just as the first harem masters are leaving.

Before the count was made it was plainly to be seen that the class formerly called "surplus bulls" was not large enough to warrant much killing. It had been the practice in 1917, 1918, and 1919 to class those animals which were found in apparently permanent position as "idle bulls" and others which evidently moved from place to place as "surplus bulls." Naturally, these latter did not constitute the whole of the class, because there were always some on the hauling grounds and in the water in front of the rookeries. Since conditions in 1920 had closely approached those of 1916 in this respect, it seemed entirely proper to follow the former practice and spare the class in the killings. By doing this there is a "margin of safety" for the breeding males which is maintained without entering into the computations.

HAREM AND IDLE BULLS AND PERCENTAGE OF IDLE BULLS TO HAREM BULLS COMPARED TO AVERAGE HAREM, 1920.

Rookery.	Date.	Harem bulls.	Idle bulls.	Total.	Idle bulls to harem bulls.	Average harem.
ST. PAUL ISLAND.					<i>Per cent.</i>	
Kitovi.....	July 18	132	57	189	43.18	28.52
Lukanin.....	do.....	95	28	123	29.47	30.96
Gorbachev.....	July 19	253	40	293	15.81	40.32
Ardiguen.....	do.....	40	8	48	20.00	29.50
Reef.....	do.....	528	70	598	13.25	44.77
Sivutch.....	do.....	190	60	250	31.58	44.08
Lagoon.....	July 20	14	3	17	21.43	24.36
Tolstoi.....	do.....	408	65	473	15.93	42.37
Zapadni.....	do.....	423	85	508	20.09	38.77
Suthetunga.....	do.....		16	16		
Little Zapadni.....	do.....	297	62	359	20.88	42.07
Zapadni Reef.....	do.....	28	5	33	17.86	19.00
Polovina.....	July 15	177	75	252	42.37	33.98
Polovina Cliffs.....	do.....	86	24	110	27.91	29.92
Little Polovina.....	do.....	49	48	97	97.96	34.92
Morjovi.....	July 17	97	99	196	102.06	30.27
Vostochni.....	do.....	725	333	1,058	45.93	45.92
Total.....		3,542	1,078	4,620	30.43	40.45
ST. GEORGE ISLAND.						
North.....	July 23	199	17	216	8.54	45.86
Staraya Artil.....	do.....	112	20	132	17.86	35.07
Zapadni.....	July 22	27	5	32	18.52	33.59
South.....	do.....	4		4		24.75
East Reef.....	do.....	67	28	95	41.79	35.37
East Cliffs.....	do.....	115	13	128	11.30	38.74
Total.....		524	83	607	15.84	36.28
Total, both Islands.....		4,066	1,161	5,227	28.55	41.20

A comparison of the foregoing table with the corresponding one for 1919 shows that there has been a reduction of harem bulls of 1,092 and of idle bulls of 1,078. There were even fewer animals in

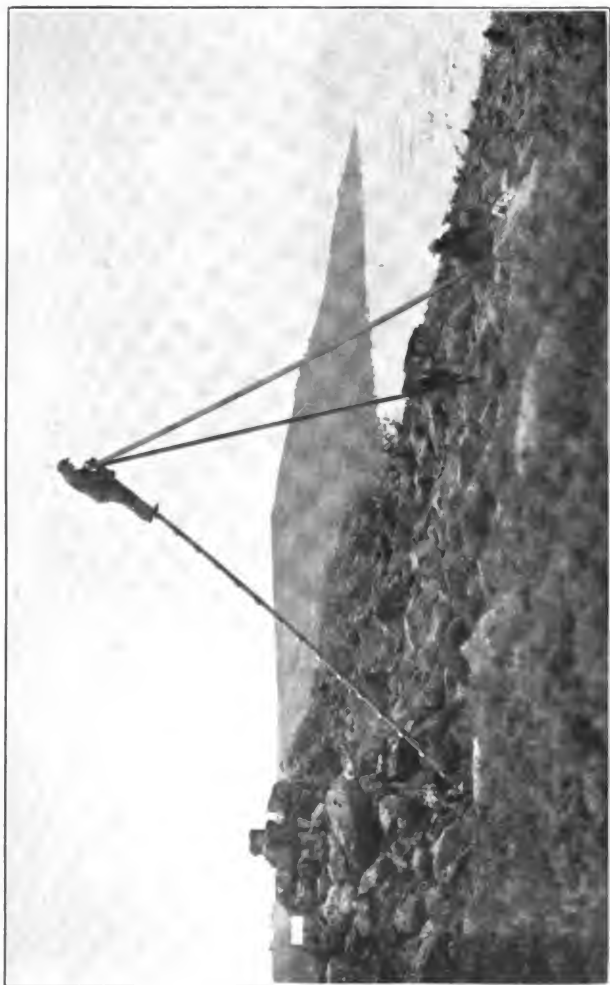


FIG. 3.—OBSERVATION TRIPOD FOR USE IN TAKING FUR-SEAL CENSUS.



these classes in 1920 than there were in 1917. Actual numbers, however, mean nothing in this connection. The important features are the ratio of idle bulls to harem bulls and the average harem. Conditions for the series of years 1912 to 1920 are best shown in tabular form as follows:

VARIATIONS IN ADULT BULL CLASSES AND RATIO OF IDLE TO HAREM BULLS, 1912 TO 1920.

Year.	St. Paul Island.				St. George Island.				Both Islands.			
	Harem.	Idle.	Ratio.	Average harem.	Harem.	Idle.	Ratio.	Average harem.	Harem.	Idle.	Ratio.	Average harem.
1912..	1,077	93	<i>Per ct.</i>	65.0	281	20	<i>Per ct.</i>	42.5	1,358	113	<i>Per ct.</i>	60.4
1913..	1,142	77	8.63	69.6	261	28	10.72	49.1	1,403	105	7.48	65.8
1914..	1,316	159	12.0	60.3	243	13	5.3	57.1	1,559	172	11.0	59.8
1915..	1,789	546	30.52	49.27	362	127	35.08	42.51	2,151	673	31.28	48.13
1916..	2,948	2,278	77.27	33.53	552	354	64.13	32.82	3,500	2,632	75.20	33.42
1917..	4,166	2,341	56.19	26.08	684	365	53.36	28.26	4,850	2,706	55.79	26.39
1918..	4,610	2,245	48.69	26.59	734	199	27.11	27.65	5,344	2,444	45.73	26.74
1919..	4,573	2,158	47.19	29.28	585	81	13.84	39.76	5,158	2,239	43.40	30.47
1920..	3,542	1,078	30.43	40.45	524	83	15.83	46.28	4,066	1,161	28.55	41.20

Thus the average harem has increased from 26 to 41, whereas there are 28 per cent as many idle bulls as harem bulls. When this is compared with average harems of 60 and 65 and with percentages of idle bulls from 8 to 11 found in 1912 to 1914, it is at once seen there was still a small oversupply of males in 1920 if conditions in the former years be considered ideal. It has not been contended that there were too few bulls in those years for breeding requirements, although it is generally believed that the ideal average harem is between 40 and 50. This was the condition in 1920, and if it can be maintained with about the same averages and ratios throughout commercial operations, those having charge of the business may well feel gratified at their success.

If we pass without comment on the good or bad judgment shown in creating the enormous surplus of male life with the closed season of 1912 to 1917, still those who have had the administration of the herd in hand deserve great commendation for bringing back an ideal condition in the short space of three years.

AVERAGE HAREM.

The average harem was determined from actual pup counts in 1920 on the same rookeries as in 1919. The gains shown on these rookeries were used as the basis in the computation of the average harem for all rookeries. Due consideration was given in every case to the topography of the various breeding areas, since it is well known that harems are smallest on rough, rocky places. Also it is known that large massed areas grow more rapidly than small scattered ones. Thus, while the harem increased but 6 on the small rookeries counted, it was computed to have increased by 10 for the herd as a whole. A good illustration of this point may be seen in the figures for 1913, when there were over 80 cows to each bull on the average for four rookeries, while many of the smaller ones ran below 40. For purposes of comparison the average harems in 1919 are given, showing graphically the increase in size of harems.

AVERAGE HAREM IN 1920 FOR ALL ROOKERIES.

Rookery.	Breeding cows.	Harem bulls.	Average harem 1920.	Average harem 1919.
ST. PAUL ISLAND.				
Kitovi.....	3,764	132	¹ 28.52	¹ 23.00
Lukanin.....	2,932	95	¹ 30.86	¹ 25.34
Gorbach.....	10,251	253	¹ 40.52	¹ 34.00
Ardiguen.....	1,180	40	¹ 29.50	¹ 25.00
Reef.....	23,038	528	¹ 44.77	¹ 31.19
Sivutch.....	8,375	190	¹ 44.08	¹ 30.50
Lagoon.....	341	14	² 21.36	² 26.18
Tolstoi.....	17,286	408	¹ 42.37	¹ 29.79
Zapadni.....	16,399	423	¹ 38.77	¹ 26.19
Little Zapadni.....	12,494	297	¹ 42.07	¹ 29.49
Zapadni Reef.....	532	28	² 19.00	² 21.57
Polovina.....	6,006	177	² 33.93	² 30.15
Polovina Cliffs.....	2,573	86	² 29.92	² 23.01
Little Polovina.....	1,711	49	¹ 34.92	¹ 31.66
Morjovi.....	2,936	97	² 30.27	² 29.69
Vostochni.....	32,857	725	¹ 45.32	¹ 30.74
Total.....	143,275	3,542	40.45	29.28
Total for rookeries counted.....	12,358	402	30.82	25.19
ST. GEORGE ISLAND.				
North.....	9,126	199	¹ 45.86	¹ 39.12
Staraya Artil.....	5,944	112	¹ 53.07	² 46.34
Zapadni.....	907	27	² 33.50	² 31.74
South.....	90	4	² 24.75	² 13.60
East Reef.....	2,571	67	² 38.37	² 31.56
East Cliffs.....	5,605	115	¹ 48.74	¹ 42.00
Total.....	24,252	524	46.28	39.76
Total for rookeries counted.....	3,577	98	36.50	39.42
Total, both islands.....	167,527	4,066	41.20	30.47

¹ Estimate.² Pups counted.

LOSSES OF BULLS AND YOUNG MALES.

In 1911 and 1912, when legislation was proposed which would prohibit the killing of the surplus males of the fur-seal herd on land, the principal objection raised was that a vast oversupply of breeding males would result. In view of the fact that commercial operations were curtailed for six years, it will be profitable to review conditions from the standpoint of the effect of the class on the herd.

The law which established the closed period of 1912 to 1917 became effective on August 24 of the former year. The action had been anticipated, however, and, since the intention of Congress was obvious, it was put into effect in the killing season of 1912. This made the closed period cover six seasons. It will be recalled that the herd had been reduced to its lowest point during American ownership in 1911 through the activities of vessel killings at sea. The major portion of the pelagic catch consisted of females. The surplus males up to 1910 were taken on land by private corporations which had leased the privilege, and in 1910 and 1911 by the agents of the Government. Under those methods over 95 per cent of the males were removed and there were left for breeding an average of approximately 1 male to 60 females. Investigators generally agreed that this ratio was sufficient.

On account of the low figure to which the herd had been reduced, however, it was feared that the vitality of the species had been

impaired. It was argued that the herd would be benefited by leaving it unmolested by man for a period of years and allowing natural selection to become effective for a time in reducing the number of males.

In a state of nature the polygamous habits of the animals are such that the removal of the excess number of males is effected by fighting. It was believed by some that only the most virile of the males would survive the battles which would inevitably result from the failure of man to remove the excess. An improvement in the breeding stock was thus anticipated. Apparently the fact was overlooked that when a finish fight between bulls takes place neither the victor nor the vanquished is of much value thereafter as a breeder. Both are exhausted.

When the law of 1912 became effective there were 1,358 harem bulls in the herd, or 1 to 59.8 cows. Naturally, no immediate increase in the number of bulls nor reduction in the average harem could be expected, hence we find practically the same condition in 1913 and 1914. It was necessary to wait until those animals 3 years old and over in 1912 became old enough and strong enough to enter the rookeries before any result would become noticeable.

In 1915 we find a slight increase in the number of bulls. The average harem was 48.13. But since those animals 3 years old in 1912 could not have entered the rookeries until they were 8 years old, or in 1917, the cause of this increase in bulls must be looked for elsewhere than from the closed season. It could not possibly result from anything but ample reserves made by the Government agents during the commercial operations in the seasons immediately preceding 1912.

The same is true for the season of 1916, when there was a further decrease in the average harem. This was undoubtedly the result of reserves made during the season of 1911 and previously.

In 1917 there was an enormous increase in the number of bulls. This was the first influx due to the closed season. The average harem went down to 26.39, which we now know to be about as small as it can go, regardless of the number of males present. The habits of the bulls are such that the massed areas would be the scene of continual and disastrous fighting if the males were separated by much less than the space occupied by the minimum average harem.

A further large increase in males in 1918 was due to the absence of killing in 1913. This increase, however, failed to reduce the size of the average harem from the minimum found the previous year. There was thus built up an enormous excess of male life, which no known means enabled us to estimate with reasonable accuracy. There were no data upon which to estimate a natural loss. Fortunately for these computations, we have had the ages of animals killed determined for several years. This is accomplished on the killing fields by measuring the length of the freshly killed animal by means of a pair of beam calipers. The measuring of a series of branded males of known age permitted the establishment of standards showing the prevailing body length for each age, and the recording, in the proper categories, of field measurements of seals killed completed the classification.

By consistent efforts the greater portion of the excess of males had been removed by 1920, so that the average harem increased to

41.20. Recently acquired information enabled the computation with reasonable accuracy of the number of adults in existence in addition to the harem bulls and idle bulls. And since we know the number of births, it now becomes possible for the first time to compute the average natural loss from the third year to maturity. It gives the first concrete information ever available upon the size of a reserve which should be made in the third year to supply the herd with stock at maturity.

In order to present the figures intelligibly, the following table has been prepared. The figures have been taken from the various census reports since 1914. Nothing has been deducted for natural mortality from the third year on. Only animals killed have been removed from the various classes.

ASSUMED MALE STRENGTH OF HERD IN 1920 EXCLUSIVE OF NATURAL LOSS.

Class.	Number in 1916.	Killed in census year. ¹					Remain der less killings.
		1916	1917	1918	1919	1920	
3-year-olds in 1912.....	2,005	.....	.....	.....	.....	.....	2,005
3-year-olds in 1913.....	11,271	104	.....	.....	.....	.....	11,167
3-year-olds in 1914.....	15,848	354	97	647	.....	.....	14,750
3-year-olds in 1915.....	18,282	2,855	614	1,058	4,302	.....	9,453
3-year-olds in 1916.....	19,402	(²)	2,771	4,690	2,950	2,001	6,990
Total.....	66,808	Total bulls remaining in 1920 if no natural loss occurred.....					44,365

¹ Animals killed in the fall of one year have been added to the killings of the following summer.

² Killings already deducted.

This table shows that out of a stock of 66,808 animals which reached the age of 3 years from 1912 to 1916, inclusive, there would remain in 1920, 44,365 if there had been no natural loss. These animals would all be 7 years old or over in 1920. The younger ages do not enter into consideration here because they could not have been counted among rookery bulls that season.

It now remains to properly divide this total among the various years and classes and derive the percentage therefrom. The problem is difficult because so many factors enter therein to modify the result, and it is necessary to take these into consideration.

As an illustration, we may consider the 3-year-old class of 1914. The animals composing it were not subjected to any unusual conditions until the seventh year. Only the usual rate of natural mortality would therefor apply during these years. But when they were approaching maturity in numbers vastly exceeding the requirements of the cows, fighting for elimination began. The younger animals would naturally be vanquished. Thus the loss during the seventh year would be excessive and still more so during the eighth and ninth. In later years the percentage of loss would doubtless increase at a regular rate and 100 per cent would be reached at maximum old age. This, unfortunately, is not known and a figure must be assumed therefor. At the present time we seem not to have any good grounds to believe many bulls exceed 15 years. This, of course, is less than the

age of females, but there are so many differences between the sexes of this species that the age of the male can no longer be based upon that of the female.

The conditions outlined above are those which are believed to exist when there is a great excess of males. If they had been removed by man so that only approximately enough remained for breeding purposes, the losses during the seventh, eighth, and ninth years would not be so heavy. Also it is probable that the bulls live longer when there is no fighting than when they have to wear themselves out in maintaining a harem position.

It, therefore, becomes apparent that conditions which obtained during 1917, 1918, 1919, are not normal and may never occur again. Everything now indicates that the younger animals suffered a practically constant mortality until the seventh year, and then their losses amounted to 50 per cent or more annually. Under normal conditions with the great excess removed by man, the loss after the seventh year would be variable and dependent upon the care given to the reserving of a proper number of bulls.

It seems unnecessary here to make arbitrary assumptions for the annual losses of the class which was termed in 1917-1919 "surplus bulls." It is definitely known that they were greater than the losses assumed and deducted. Thus in 1919, 50 per cent was estimated to have been the loss from the third year to and including the surplus bull class; that is, animals 7 years old and over. If the loss had been estimated at 50 per cent from the third year to the seventh and at least that much annually thereafter, it would have come nearer the actual condition. But there was nothing until 1920 which would cause one to suspect that the loss had been so enormous.

It now remains to determine what the annual loss of males is from the third year on, when average conditions accompanying commercial work exist. A division which is more or less arbitrary for all ages is as follows: First year, 35 per cent; second, 15 per cent; third, 10 per cent; fourth, 10 per cent; fifth, 10 per cent; sixth, 20 per cent; seventh, 20 per cent; eighth, 25 per cent; ninth, 30 per cent; tenth, 40 per cent; eleventh, 50 per cent; twelfth, 60 per cent; thirteenth, 70 per cent; fourteenth, 80 per cent; fifteenth, 100 per cent.

Considerable of the above is conjecture, but it is believed to represent fairly accurately the conditions existing in 1920. It will be noted that there is a slight revision of the percentages lost from the first to the third year. This does not materially affect the result and gives a working basis for the future. Doubtless additional investigation will adjust any irregularities in the table. It has been used in the preparation of the final census for 1920.

These new percentages of loss were obtainable in 1920, because early in the season it was seen that the surplus believed to be in existence from the accumulation of the closed period did not appear. It was evident that if the bulls were coming at all they would have been at the islands before the middle of July. Since they did not appear at that time it was recommended that no more be removed from the herd. As it turned out the counts at the height of the season showed that a few more could have been removed with safety.

COMPLETE CENSUS OF FUR SEALS AS OF AUGUST 10, 1920.

Pups, counted and estimated.....	167,527	
Breeding cows, 3 years old and over, by inference.....	167,327	
Harem bulls, counted.....	4,066	
Idle bulls, counted.....	1,161	
Yearlings, male and female, estimated:		
Pups born in 1919.....	157,172	
Deduct 35 per cent for natural mortality.....	55,010	
Yearlings, both sexes, beginning 1920.....	102,162	
Yearling females, 50 per cent, Aug. 10, 1920.....	51,081	51,081
Yearling males, beginning of 1920.....	51,081	
Yearling males killed in 1920.....	7	
Yearling males, Aug. 10, 1920.....		51,074
2-year-olds, male and female, estimated:		
Yearling females, Aug. 10, 1919.....	46,447	
15 per cent deducted for natural mortality.....	6,967	
2-year-old females, Aug. 10, 1920.....		39,480
Yearling males, Aug. 10, 1919.....	46,444	
Yearling males killed, fall of 1919.....	7	
Yearling males, end of 1919.....	46,437	
15 per cent deducted for natural mortality.....	6,966	
2-year-old males, beginning of 1920.....	39,471	
2-year-old males, killed in 1920.....	300	
2-year-old males, Aug. 10, 1920.....		39,111
3-year-old males, estimated:		
2-year-old males, Aug. 10, 1919.....	33,081	
2-year-old males killed, fall of 1919.....	214	
2-year-old males, end of 1919.....	32,867	
10 per cent deducted for natural mortality.....	3,287	
3-year-old males, beginning of 1920.....	29,580	
3-year-old males killed in 1920.....	18,831	
3-year-old males, Aug. 10, 1920.....		10,749
4-year-old males, estimated:		
3-year-old males, Aug. 10, 1919.....	13,596	
3-year-old males killed fall of 1919.....	820	
3-year-old males, end of 1919.....	12,776	
10 per cent deducted for natural mortality.....	1,278	
4-year-old males, beginning of 1920.....	11,498	
4-year-old males killed in 1920.....	5,831	
4-year-old males, Aug. 10, 1920.....		5,667
5-year-old males, estimated:		
4-year-old males, Aug. 10, 1919.....	5,747	
4-year-old males killed fall of 1919.....	66	
4-year-old males, end of 1919.....	5,681	
10 per cent deducted for natural mortality.....	568	
5-year-old males, beginning of 1920.....	5,113	
5-year-old males killed in 1920.....	106	
5-year-old males, Aug. 10, 1920.....		5,007

6-year-old males, estimated:

5-year-old males, Aug. 10, 1919	5,282	
5-year-old males killed fall of 1919	37	
5-year-old males, end of 1919	5,245	
20 per cent deducted for natural mortality	1,049	
6-year-old males, beginning of 1920	4,196	
6-year-old males killed in 1920	43	
6-year-old males, Aug. 10, 1920		4,153
Surplus bulls (7-year-olds and over), estimated:		
6-year-old males, Aug. 10, 1919	8,991	
6-year-old males killed fall of 1919	800	
6-year-old males, end of 1919	8,691	
20 per cent deducted for natural mortality	1,738	
7-year-old males, beginning of 1920	6,953	
Surplus bulls, Aug. 10, 1919	9,619	
Surplus bulls killed fall of 1919	980	
Surplus bulls, end of 1919	8,639	
30 per cent deducted for natural mortality	2,592	
Remaining surplus bulls for 1920	6,047	
Breeding bulls of 1919	7,397	
30 per cent deducted for natural mortality	2,219	
1919 bulls remaining in 1920	5,178	
Breeding bulls in 1920	5,227	
1919 bulls remaining, deducted	5,178	
Increment of new bulls in 1920	49	
7-year-old males computed for 1920	6,953	
Surplus bulls computed for 1920	6,047	
Total theoretical surplus bull stock for 1920	13,000	
7-year-olds and over killed in 1920	721	
Total surplus in 1920	12,279	
Increment of new breeding bulls in 1920, deducted	49	
Surplus bulls in 1920	12,230	
50 per cent deducted for abnormal losses due to excessive number of bulls	6,115	
Surplus bulls, Aug. 10, 1920		6,115

RECAPITULATION.

Pups	167,527
Cows	167,527
Harem bulls	4,066
Idle bulls	1,161
Yearling females	51,081
Yearling males	51,074
2-year-old females	39,480
2-year-old males	39,111
3-year-old males	10,749
4-year-old males	5,667
5-year-old males	5,007
6-year-old males	4,153
Surplus bulls (males 7 years old and over)	6,115
Total	552,718

NATURAL-HISTORY RECORDS OF PRIBILOF ISLANDS.

By G. DALLAS HANNA.

It seems to be highly desirable that there shall be published in a readily accessible place a résumé of the scientific work which has been done in connection with the biology of the Pribilof Islands. This group of islands has been more intensively studied than any other similar area in Alaska and will continue, doubtless, to attract attention in the future. Records of publications on the various groups of plants and animals are often widely scattered, and employees of the Bureau stationed on the islands have little opportunity to search for them.

The last bibliography of the subject was published in 1915 in a report by Osgood, Preble, and Parker.¹ This list was known to be incomplete at the time of its preparation and was intended to cover the subject "fur seals" only. Yet it is very valuable to anyone who has occasion to study the literature of the Pribilof Islands.

The following list is the result of note taking through several successive years and is intended to cover the general natural history of the islands in so far as I have the records. It also is known to be incomplete, but it takes up the most important work which has been done since the appearance of the above-mentioned bibliography. In some cases papers published prior to 1914 are included because of their interest to island students.

It should be explained that in addition to the following titles many Pribilof Islands records are contained in general publications which are not listed. For instance, Dall² has mentioned a large number of marine mollusks from the Pribilofs in his work on Northwest Coast Shells. The same is true of birds in Ridgway's "Birds of North and Middle America,"³ Hamilton's "Coleoptera of Alaska,"⁴ Evermann and Goldsborough's "Fishes of Alaska,"⁵ and others. A new work is expected from the National Herbarium soon and it will contain full records of Alaska plants, including those from the Pribilof Islands.

The report of Alaska Fisheries and Fur Industries in 1918 (Bureau of Fisheries Document No. 872, pp. 105-107) contained a check list of birds of the Pribilof Islands, Alaska, with the names of persons first recording the species from the islands. This list contained names of 129 species and subspecies. It has been increased by six, the first three added in 1920, the fourth restored on evidence col-

¹ The Fur Seals and Other Life of the Pribilof Islands, Alaska, in 1914. Bulletin, Bureau of Fisheries, Vol. XXXIV, 1914 (1916), pp. 149-167. Washington, 1915.

² U. S. National Museum, Bulletin 112. 1921.

³ U. S. National Museum, Bulletin 50.

⁴ Transactions, American Entomological Society, Vol. XXI, pp. 1-38. 1894.

⁵ Bulletin, U. S. Bureau of Fisheries, Vol. XXVI, pp. 219-360. 1906.

lected during the winter of 1919-20, and the remaining two recorded in 1921:

- Limnocyptes gallinula*, European Jack-snipe.^{1, 2}
Macrorhamphus griseus scolopaceus, Long-billed Dowitcher.³
Passerella iliaca unalaschensis, Shumagin Fox Sparrow.³
Corvus corax principalis, Northern Raven.
Micropus pacificus, Japanese Swift.^{2, 3}
Loxia leucoptera leucoptera, White-winged Crossbill.³

This brings the total number of species known from the Pribilof Islands up to 135. All but six of these records are supported by specimens in some public museum. Since the 1918 list was compiled the little brown crane has been collected, but the restoration of the raven keeps the number of uncollected species the same as at that time.

In the paper by Mailliard and Hanna³ a few corrections of former records were made. It was decided that the citation of *Arquatella maritima couesi*, Aleutian sandpiper, from the Pribilof Islands, by Seale⁴ was unwarranted, and the record would have to be based on later work. A specimen taken on St. George Island February 12, 1917, by G. Dallas Hanna, was referred to in support of the record. The specimen is now in the National Museum.

The credit for recording *Pisobia acuminata*, sharp-tailed sandpiper, was given to Bishop⁵ in the 1918 list as Grinnell⁶ had done. Seale, however, had recorded it three years previously.⁴

The record of *Larus hyperboreus hyperboreus*, glaucous gull, by Oberholser, cited in the 1918 list, is rather obscure. It is to be found in *The Auk*, Volume XXXV, No. 4, page 470, October, 1918. The subspecies *L. h. barovianus*, first taken by Palmer, is also listed by Oberholser from the Pribilofs on page 473 of his article.

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¹ Hanna, G. Dallas: New and interesting records of Pribilof Island birds. *Condor*, Vol. XXII, No. 5, pp. 173-175, September, 1920.

² New to North America.

³ Mailliard, Joseph, and G. Dallas Hanna: New bird records for North America with notes on the Pribilof Islands list. *Condor*, Vol. XXIII, No. 3, pp. 93-95. 1921.

⁴ Seale, Alvin: Notes on Alaskan water birds. *Proceedings, Academy of Natural Sciences, Philadelphia*, Vol. 50, 1898, p. 139.

⁵ Bishop, Louis B.: Birds of the Yukon region, with notes on other species. *North American Fauna*, Vol. 19, p. 66. 1901.

⁶ Grinnell, Joseph: Record of Alaskan Birds in the collection of the Leland Stanford Junior University. *Condor*, Vol. III, p. 19. 1901.

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 1908: pp. 593-658. Also published as House Document No. 63, 62d Cong., 1st sess.
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 1910: pp. 1011-1044. Uncorrected page proof. Also published as U. S. Bureau of Fisheries Document No. 749 and in *Fur Trade Review*, December, 1911, and succeeding numbers.

[While these reports are largely of an administrative character, they contain a great deal of information on the censuses of fur seals for the several years mentioned.]

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INVESTIGATION OF THE SALMON FISHERIES OF THE YUKON RIVER.

By CHARLES H. GILBERT and HENRY O'MALLEY.

OUTLINE OF PROPOSED INVESTIGATIONS.

An exhaustive investigation of the problems presented by the salmon run of the Yukon River obviously would require practical and scientific inquiry extending over a series of years. During the few summer months no very ambitious program could be attempted. Many of the most important problems must remain untouched. Time would not permit an examination of the tributaries with their spawning beds. No study could be made of spawning habits nor observation of the fate of eggs and fry where these must lie beneath the gravel of the ice-locked streams during the long severe winter and spring. Yet the possible destruction of eggs by freezing may be an important factor in limiting the size of salmon runs in far northern rivers and may, indeed, be responsible for the practical elimination of salmon from the streams that enter the Arctic Ocean. If natural propagation on the Yukon is rendered relatively ineffective because of severe climatic conditions, the operation of hatcheries would here produce proportionately greater results than in more temperate regions. To the extent that natural propagation in any region is wasteful and unproductive do the advantages of artificial propagation appear.

In a single short season it could not be hoped to carry out more than the following program:

1. To inspect the spawning runs as these enter the mouth of the river and to ascertain by microscopic examination of the scales as much as this method can furnish of the life history of the Yukon salmon.
2. To examine the fishery operations carried on by the Carlisle Packing Co., in the Delta of the Yukon, this being the only cannery which packs salmon bound for the spawning beds of the Yukon.
3. To investigate the consumption of fresh and dried salmon by the resident population of the Yukon Valley and to estimate the importance to them of this salmon supply.
4. To draw such conclusions as the facts warrant concerning the magnitude of the Yukon salmon run and its adequacy to support cannery operations in addition to meeting the needs of the local population and providing a sufficient spawning reserve.

ITINERARY.

In carrying out the program above outlined the writers arrived in Skagway on May 12 and crossed White Pass and Lake Lebarge in time to take the first steamer down the Yukon, close behind the running ice of the spring breakup. At Tanana, which was reached May 31, transfer was made to the gasoline launches of the Bureau of

Fisheries, and from June 8 to 13, in company with C. F. Townsend, inspector, Alaska Fisheries Service, the party proceeded by launch to the mouth of the river, arriving June 13 at the entrance to Kwiguk Channel, where was located the floating cannery of the Carlisle Packing Co.

From this date until August 1 attention was given to the fishing grounds located in the Kwikluak mouth of the river and in the off-shore district beyond this mouth, and to the principal channels of the delta which are closed to commercial fishing. From June 25 to July 1 the party proceeded by launch from Kwiguk to Holy Cross and return, to inspect the fishing camps of the lower river during the height of the king-salmon run. From July 5 to 7 a trip was made by launch from Kwiguk to the middle mouth of the Yukon, traversing both the Kwikpak and the Kawanak Passes, returning by way of Old Fort Hamilton, and inspecting en route the run of salmon in these channels. From July 23 to 29 a trip was made by steamer from Kwiguk to St. Michael and return, passing through the Apoon mouth. During the fishing season in the delta careful scrutiny was given daily to the salmon runs, and scale data were secured from extensive series of the different species of salmon which comprise the run.

From August 2 to 20 visits were made to fishing camps along the river from Kwiguk to Rampart, an approximate census secured of the amount of dried salmon, and fishermen interviewed concerning the runs of 1919 and 1920. Having proceeded by steamer from Rampart to Dawson, August 23 to 31, the return was made by launch from Dawson to Tanana, September 1 to 5, visiting on the way the fishing camps of the upper river. This phase of the inquiry terminated at Fairbanks on September 11, after ascending the Tanana River by launch as far as Nenana.

IMPORTANT SPECIES OF SALMON WITH DATA CONCERNING RUNS.

All five of the species of salmon known on the Pacific coast of North America make their appearance at the mouth of the Yukon and ascend that stream for a greater or less distance. Two of these species, however, the humpback salmon and the red or sockeye salmon, are present in such limited numbers as to have no practical significance. The three other species, namely, coho or silver, king, and chum or dog salmon, have substantial runs in the Yukon River, the latter two being of real economic importance.

RED OR SOCKEYE SALMON.

During the entire fishing season of 1920 the Carlisle cannery secured only 5 cases of sockeye salmon, in the neighborhood of 60 fish. As the majority of these were taken on the flats outside the mouth of the river, there might seem warrant to consider them as strays which had wandered from the Kuskokwim, or from some other stream to the southward which possesses a well-marked run of this species. In that case they might not even be entering the river, but playing about for a time in brackish water before finally resorting to their native streams for spawning purposes. In favor

of this theory stands the fact that no breeding ground of the red salmon has yet been reported from any part of the Yukon Basin. The breeding ground of this species could be looked for only in connection with some lake, as the red salmon will not spawn under other than lake conditions. And the males of the species, when on the spawning grounds along the shores of a lake, or in the shallows of the creeks which enter it, are of such brilliant color as invariably to attract attention. It may be, therefore, that no permanent colony of red salmon exists in the Yukon, and that the major portion of the individuals observed off the mouth of the river would not enter and ascend the stream. Occasional individuals do, however, ascend the Yukon, for the writers learned of their infrequent occurrence from observers acquainted with the different species of salmon, and one specimen (a male, decidedly pink in color) was seen at Ruby on August 14. During the much longer fishing season of 1919, 20 cases of red salmon were packed by the cannery.

HUMPBACK SALMON.

The humpbacks appear at the mouth of the river more numerous than the red salmon, but never in sufficient numbers to constitute a run, even of small dimensions. It was noticeable that they were far advanced toward spawning in July, often with liquid milt and partly free eggs. It would be impossible for them to ascend the river far with their spawning period so close at hand. In fact, there were no reports of their occurrence above Andreafski, where a ripe male was observed on August 3.

COHO SALMON.

The least in value of the three principal species is the coho, which runs much less numerous than the other two, and, in addition, is the latest to appear, often not presenting itself in any numbers in the middle and upper reaches of the river until the ice is forming in the fall. This species is little dried on account of its late appearance, but may be fed fresh to the dogs or frozen for later consumption. It seems not to be highly valued for human food.

During the season of 1920 it was entering the mouth of the river in very limited numbers during the last week in July, but nothing approximating a run had at that time developed. The individuals then entering were bright silvery on the sides of the body, without trace of the red coloration which later appears, and the jaws of the male had developed no hook. Later, while inspecting the fishing camps between the mouth of the river and Tanana, from August 2 to 15, everywhere occasional individuals of this species were being taken. At Ruby on August 14 the fish wheels were catching from one to six cohos each day; but at the Ramparts above Tanana on August 20 the species had not yet put in an appearance, nor could anything be learned of its occurrence in the main river above Tanana up to the date of the party's return from Dawson on September 5. The individuals observed below Tanana were running principally along the left (south) limit of the river, and it was reported that their main run was always along the left bank in company with the bright chums ("silver") and such king salmon as run late. To what

extent the early cohos turn into the Tanana it was impossible to determine.

In the lower two or three hundred miles of the river the cohos during the early days of August may maintain the bright silvery coloration with which they enter from salt water, but soon a pinkish tinge appears, which becomes intensified to a bright red before Ruby is reached. At the same time the upper jaw of the male becomes bluntly hooked over the lower jaw, producing the characteristic snub-nosed appearance of this species on the spawning grounds, and the enlarged teeth of the males are soon in evidence. These changes in appearance may have already occurred before entering the river in the case of the latest individuals to enter.

It is most unfortunate that the only name by which the coho salmon is commonly known on the Yukon is "chinook," which is the special name of the king salmon of the Columbia River and is totally inapplicable to the coho. Near the mouth of the Yukon, where the influence of the cannery has been felt, the coho is generally and properly designated as the silver salmon, which is one of the two names by which the species is known in other fishing centers of Alaska. Unfortunately, as will later appear, elsewhere throughout the Yukon the term "silver salmon" is generally but mistakenly applied to an entirely different species. To avoid confusion, therefore, it is suggested that this species be known on the Yukon as the coho, a name by which it is generally known to the trade.

KING SALMON.

The king salmon appears at the river mouth shortly after the ice has run out—in the last week of May or the early days of June. The numbers rapidly increase, the run culminates quickly, and then almost as quickly declines. During the season of 1920 the first king salmon was obtained on June 13, although nets had been set to test the grounds for five days prior to that date. The rapidity with which the run sets in is well shown by the records of the first few days at the cannery. On June 15, 34 king salmon were obtained; on June 16, 175; June 17, 1,639; and on June 18, 5,228, this being the next to the largest take on any day during the season. The largest capture of king salmon in any one day was 6,104 on June 21. In no other day, except the two above mentioned, did the number captured quite reach 4,000. The run may be said to have begun on June 15 and to have culminated within the first week. It continued for some 10 days thereafter at a high level, and then registered unmistakable decline. The average take at the cannery for the best consecutive 16 days of the run was a little more than 3,000 fish per day.

The experience during the previous season, 1919, was very similar as regards the beginning, culmination, and decline of the king salmon run. The fish appeared during the second week in June, ran most abundantly during the following week, continued at a high level for two weeks more, and then rapidly fell off.

The average size of the 1920 king salmon was greater than that of 1919, as is shown by the average number required to make a case in each of the two years. The average number in 1919 was 3.54 to the case, while in 1920 it required but 3.03. The difference was even

greater than is indicated by these figures, for in 1919 comparatively few fish of larger size were taken out for mild curing, while in 1920 there were put up 145 tierces of mild-cured kings, with 800 pounds to the tierce. These were all selected from the larger sizes and would have materially diminished the number required per case if all had been canned.

During the early part of the fishing season the king salmon were silvery in color, without trace of red; the testes are small, hard, and purplish in color; the eggs are always small, not more than half the size when mature. The snout of the males was then so little produced as to give no certain indication of sex. This condition continued during the greater part of June, near the latter end of which the run indicated a decided falling off. But on June 29 a second run appeared of small dimensions, and it was at once apparent that these fish were further along in their development. The jaws of the male were now somewhat prolonged and hooked, and the enlarged teeth had begun to show. They were now reddish in color, and the bellies were so thin that they were little valued for mild-cure purposes. These changes were abrupt and coincided with the sudden increase in the run.

The natural enemies which left traces of their presence on the entering salmon were the white whales, or belugas, and the lamprey eels. Belugas were very much in evidence in the lower river channels during the latter part of the season, the size of their schools increasing as the salmon were running more abundantly. Undoubtedly they were feeding on the salmon, and it is safe to assume that they captured and devoured a very large proportion of those on which they succeeded in closing their jaws. But the number of salmon which appeared on the cannery floor bearing unmistakable tooth marks of the beluga was surprising. The sides were scored lengthwise by widely spaced lines, which usually described a gentle curve, but were occasionally angulated. Evidently these salmon had escaped from the very jaws of their pursuers.

Other marks which attracted universal attention and were usually mistaken for hatchery brands were the scars made by the lamprey eel. This slender eel-shaped animal has an oval sucker-shaped mouth provided with rows of rasping teeth. By means of the sucker mouth it attaches itself to the salmon and may rasp off the skin and even deeper-lying tissues for food. A scar is left which often reproduces with great fidelity the details of the mouth, with its outer fringe of filaments and its inner groups of teeth, which in the scar often give the impression of printed characters.

Such lamprey scars have been occasionally observed in other rivers, but never before in such abundance as on the Yukon. This fact probably stands related to the large lamprey run which is indigenous to this stream. They enter the mouth of the river in the fall after the surface has frozen and run up under the ice, to the under surface of which they often attach themselves when resting. Although the run lasts but few hours at any locality, it is of enormous dimensions and furnishes tons of food to those who dip them up through holes cut in the ice.

Like the salmon, the lampreys enter the river for purposes of propagation, and all die after the eggs are laid. The young soon

after hatching burrow in the mud of the river banks and live like earthworms for an indefinite period of two or more years. After this they pass out to sea when some 6 inches long, and spend the remainder of their life in the ocean. So far as known to the writers, the lamprey scars have been found on salmon exclusively, and on the Yukon never on chums or dog salmon. Some king salmon would have two or even three scars and one was found on a sockeye, but among the thousands of Yukon chums that we inspected there was not one that had been attacked by a lamprey. It is an interesting question whether the Yukon lampreys follow the king salmon of their own river on their feeding grounds and prey on them. It is not known that their attacks are ever dangerous. The salmon observed seemed in no case to have been seriously injured.

That the king salmon ascend the Yukon at a high rate of speed has been accepted generally. An attempt was made to secure reliable records of their first appearance at a large number of localities along the river. Wireless messages were sent to a number of points during the early days of the run before the dates should be forgotten. And, in addition, a number of important records were secured during visits to the fishing camps, some of these giving the catch in detail day by day throughout the season. While it is recognized that the capture of the first salmon of the season at different points along the river may vary within a day or two in relation to the beginning of the run, an examination of the data indicates that this source of error is not serious and that reliable conclusions concerning the rate of travel can be drawn from the table presented. In this table, when two or more records have been obtained from the same locality, the earliest has been selected as giving the first appearance of the king salmon in that portion of the river.

DATE OF CAPTURE OF FIRST KING SALMON AT LOCALITIES ON YUKON RIVER, SEASON OF 1920.

Locality.	Date.	Approximate distance traveled.
		Miles.
South mouth of river.....	June 13	.....
Run begins south mouth.....	June 15	.....
Pilot Station.....	June 20	107
Marshall.....	do.	144
Russian Mission.....	June 21	204
Tucker's fish camp.....	June 23	221
Palmut.....	June 22	250
Holy Cross.....	June 23	279
Halls Rapids, above Anvik.....	June 24	346
Camp 51 miles below Kaltag.....	June 27	440
Kaltag.....	June 28	491
Koyukuk.....	June 29	555
Whisky Creek, above Loudon.....	June 27	622
Ruby.....	do.	659
Tanana.....	June 28	804
Fish Creek, above Rampart Rapids.....	July 3	851
Circle.....	July 11	1,227
Charlie Creek.....	July 12	1,317
Eagle.....	July 13	1,402
De Wolf's fish camp.....	July 14	1,478
Dawson.....	do.	1,504

Inspection of the above table shows the slowest rate of travel in the first hundred miles of the river above its mouth. From the entrance of the South Mouth to Pilot Station is approximately 130 miles, but it was five days after the run began in the mouth of the river before the first king salmon appeared at Pilot Station, indicating a rate of about 30 miles per day. Between Pilot Station and Tanana, on the other hand, the rate of travel was slightly more than 80 miles per day. This discrepancy is probably due to the habit of playing back and forth in brackish water, on entering the river mouth, before beginning their serious ascent of the river. It is well known to the fishermen at the mouth of the river that salmon enter the gill nets as numerously from the upstream as from the downstream side. They pass back and forth on the tides, lingering within the fishing district, thus giving the nets many more opportunities to capture them than would be the case if they pursued a direct course on entering the stream.

Three records below Tanana, those of the camp 51 miles below Kaltag, Kaltag itself, and Koyukuk, do not align themselves with the remainder of the series. At the average rate of travel king salmon should have reached Kaltag by the 24th instead of the 28th and Koyukuk by the 25th instead of the 29th. In both of these localities the capture of king salmon was considered of little relative importance, and the records are doubtless defective.

Above Tanana the current of the river increases materially, rapids are encountered, and the intricate channels of the Yukon Flats are to be threaded. It is not surprising to find that the rate of travel in the upper portion of the river becomes reduced. Not only are the difficulties of ascent increased but the potential store of energy in the fish approaches exhaustion. When they enter the mouth of the river they are the richest in oil of any salmon known, but by the time they reach Dawson their flesh is comparatively dry and flavorless, the oil having been expended to supply the energy needed in ascending 1,500 miles against the current and in carrying forward at the same time the sexual changes which precede the act of spawning. The average rate of travel from Tanana to Dawson was slightly less than 45 miles per day, while from Pilot Station to Dawson, involving practically the entire length of the river below Dawson, the average rate was 57 miles per day.

No record of any other river approaches this in completeness nor in the high rate of travel indicated. The unexampled speed with which salmon ascend the Yukon is doubtless associated with the great distances to be traversed before reaching their upper spawning areas, taken in connection with the shortness of the northern summer.

Inasmuch as the investigators were compelled to restrict their attention to the main river, they are unable to designate the principal spawning areas of the king salmon. Limited numbers of kings are reported to turn aside into all the principal tributaries of the lower and middle sections of the river, but it is believed that a relatively large proportion of the run passes beyond the mouth of the Porcupine into the upper portion of the basin.

CHUM OR DOG SALMON.

Although the king salmon is an important source of food to the natives and the white population, it is far surpassed in value by the

chum or dog salmon, which must be considered the principal food product of the Yukon River.

It makes its appearance off the mouth of the river only a few days later than the advent of the king salmon. In 1920 the first chum was obtained June 17, and from the 17th to the 19th, 138 became entangled in the coarse mesh of the king salmon nets set outside the mouth of the river; but none apparently had as yet entered the stream. On June 20, 2 were reported inside the river; June 21, 82; and June 22, 26; but during these three days 856 were taken in the outside nets, indicating clearly that the chums were beginning to school in some abundance outside the river, but that few were entering up to June 22, when the run up the river may be said to have begun. It became greatly accelerated on June 29 and maintained itself with minor fluctuations, until the cannery ceased operations the middle of July. No strictly quantitative results concerning the run of chums could be obtained from the cannery records during this season, as nets with appropriate mesh for capture of chums were not employed until the last week in June. For this reason, the apparent increase in size of run during the latter days of June is certainly overemphasized by the cannery statistics.

The first chums to arrive were further advanced toward sexual maturity than were the king salmon. In the latter the testes and ovaries were small and the snout so little produced in the males that there was no certain external evidence of the sex of the individuals examined. But in the case of the chums, even those earliest to run had the milt white in color and obviously enlarged, and the large eggs were already loosening in the ovary. The jaws of the males were not hooked, but were showing a slight sharpening and elongation, so that sex determination could usually be made from the appearance of the head. All the early chums were bright silvery in color, with abundant oil, and pinkish flesh which turned a deeper red on drying. All of them were in such condition that they would have been classed as "silvers" rather than as "dog salmon" by fishermen of the upper river.

But changes in the appearances of the chums were soon apparent. At first, as in the case of the king salmon, rare individuals, usually males, showed themselves in an advanced stage of development, with brightly colored bars on the sides of the body and long hooked jaws. They stood out conspicuously from their fellows, which were still in the "silver" stage.

But by the last of June, when a great increase suddenly occurred in the take of chum salmon, obvious seasonal changes had appeared in this species, as in the king salmon running at the same period. It was now the rule for the males to exhibit elongated jaws provided with canine teeth, and to show the beginnings of the conspicuous color marks which characterize the spawning males of this species. During the first days of July the run of chums again fell off, accompanied by a further increase in the matured appearance of the fish. As this occurred at the same time in chums and in king salmon, it appeared to the fishermen that the end of the run was in sight.

On July 7 a new run of chums suddenly set in, the great majority of which were of bright silvery appearance and with no further seasonal advancement than had been shown by the fish that ran first in June. Among them were a few stragglers of the previous run, the

males and females equally conspicuous among their silvery companions. On subsequent dates these stragglers became more rare, and when the party left for the upriver on August 2 the few chums that were then running were almost wholly of the pronounced silvery type.

It is unfortunate that confusion should have arisen in the Yukon from a failure to recognize that the dog salmon and the so-called "silvers" represent different phases in the development of one and the same species.

The "dog salmon" are the individuals furthest advanced toward spawning. They exhibit the elongated hooked jaws and enlarged teeth in the male, the bright nuptial coloration, and the impoverished condition of the flesh, which is light in color, largely devoid of oil, and possessing very little substance when dried.

In the "silvers" the eggs and milt are less developed, the jaws of the male are little or not at all hooked, the external coloration is silvery, or with a light flush of red, and the meat is red in color when dried, rich in oil, and valuable both for human food and for dogs.

In general, the "dog salmon" along any stretch of the river consist of those individuals which will turn into some adjacent tributary to spawn, while the "silvers" are on their way to the upper reaches of the river, show relatively little of the sexual changes they will exhibit on their spawning beds, and are still richly provided with the oil which serves as fuel and principal source of nourishment during the long journey still before them.

Many fishermen recognize the difficulty of distinguishing sharply between "dogs" and "silvers" and relieve their embarrassment by recognizing a third class, the "half-breeds." But the term "silver salmon" has acquired a fairly definite and useful significance in the trade. "Dog salmon" are so poor in nourishment that they have indifferent value even for dog feed, and will not be purchased except during times of extraordinary scarcity. The natives will feed them to their dogs, but will not eat them themselves unless king salmon and "silver salmon" are unobtainable.

The use of the term "silver salmon" for bright silvery chums, still rich in substance, is so universal and of such long standing in the interior of Alaska that it seems useless to attempt to supplant it with any other name. Confusion will inevitably result owing to the presence of the totally different species, the coho, which is commonly known in outside waters as the silver salmon. It is proposed, therefore, that the term "silvers," when referring to the Yukon basin, be restricted to the chums known commercially by that name, while the three species of salmon of importance on that stream be known as the king, the chum, and the coho.

It became evident, as we were ascending the river in August, that the "dogs" and the "silvers" were in general keeping apart from each other and were following distinct migration routes. Throughout the entire lower course of the Yukon, from Tanana at least as far as Anvik, the "dogs" predominated on the right (north limit) of the river and the "silvers" on the left limit. This is generally recognized by all the fishermen of that region, who also agree that the "dog salmon" turn into all the creeks and smaller tributaries, while the silvers "dislike the taste of fresh water," as a native fisherman stated the case. It is also recognized that a heavier run of kings and

of cohos is found in company with the "silvers" along the left limit of the river. It appears, therefore, that there is a prevailing use of the left shore by those fish which are bound for the upper reaches of the river. This may have connection with the fact that the majority of the tributaries of the lower river enter on the right bank.

The run of chums is not of uniform character and quality throughout the season. Fishermen recognize a succession of phases in the run, characterized by fish which on the average are recognizably different. In general, it is stated that the run of chums which accompany the king salmon are of relatively small size and poor quality, commonly known as dog salmon. Following these is a run of bright fish of good quality but inferior size, known as "silvers," while the last chums to run, late in August and early in September, are the finest of all, the "silvers" par excellence, a bright rich form distinctly of larger size. This last run of "silvers" ordinarily is of short duration, but is frequently of great intensity, and furnishes the most highly prized fish of the season.

As it was necessary to make a canvass of the entire river before the fishing season had come to a close, the writers were unable to observe the alleged succession of forms of the chum salmon at any locality. Distinct differences in the character and quality of the fish appeared at the various camps visited, but these differences were apparently dependent either on the proximity of the camp to important tributaries into which spawning chum salmon would pass, or, more especially, on the location of the camp with reference to the river itself, whether on the right bank or the left. In general when following up the right (north) bank of the river the quality of the fish became poorer as one approached the mouths of the tributaries. The impression was strong that the fish destined for these tributaries were farther advanced than those with which they were associated on the same side of the river bound for more distant spawning grounds. A further more detailed study of the characteristics of the chums at different times and in different localities and the distribution of the various strains to their respective spawning areas would offer results of importance equally from the biological and from the strictly practical point of view. During the season of 1919 the bright chums, or "silvers," were said to be almost wholly wanting. If these were the fish bound for the more distant spawning beds, then the upper sections of the river must have remained largely unseeded in 1919 and incapable of producing their quota of a subsequent season's supply. In 1920 the run of chums was peculiar, in that it lasted longer than is usual in good years, but was of less intensity, and the August run of "silvers" failed to attain its usual proportions. In subsequent years the late run of "silvers" should be carefully noted. If there is evidence of a progressive decline, steps should be taken to protect this most important part of the run. To accomplish this result information should be obtained concerning the spawning beds which are resorted to by this large and valuable race of chums.

The chums travel up the river at a rate approximately equal to that of the king salmon. In 1920, as has been shown, they were schooling on the tide-flats off the mouth of the river nearly a week before they began to ascend the stream in any numbers on June 22. Adopting the latter date as the beginning of the run, it appears that they

started about a week later than the king salmon. In the section of the river between Loudon and Tanana, they were reported as 8 to 10 days behind the kings, and in the district between Circle and Dawson, the first chum was recorded 11 to 17 days later than the first king. It is evident, therefore, that the chum salmon, also, although apparently far less vigorous than the king, ascend the river at an astonishing rate of speed, maintained without cessation for well over a month, under the necessities imposed on them by the short summer and the rigorous fall climate of the Yukon.

The opinion has already been recorded that the king salmon of the Yukon is the richest in oil of any known king salmon. The same statement, made with even greater emphasis, may be advanced regarding the Yukon chums. This species is noted in other localities for its poor oil and poor color. The canned product is the reverse of attractive in color or in richness, and occupies the lowest rank in the markets of the world. In other river basins the chums do not travel far from the sea, but enter late in the season and seek spawning beds not far inland. But the best of the Yukon chums travel 1,000 to 2,000 miles up a river known for its consistently rapid current. They form a rich table fish in the lower section of the Yukon, where the king salmon, to ordinary palates, contains a superabundance of oil. No more striking evidence of the richness of the king salmon can be found than that presented in the smokehouses of natives in the lower river. Here the drying salmon constantly drip a pure, clear red oil, which is collected in vessels and preserved for winter use. At the village of Ohogamute, above Marshall, we observed some 30 quart bottles filled with red salmon oil, secured this season from drying king salmon.

YUKON DELTA, ITS PRINCIPAL CHANNELS, AND ROUTES MAINLY FOLLOWED BY SALMON.

The Yukon River subdivides numerous within its extensive delta, and sends its waters to the sea through a large number of distinct channels. Many of these are narrow winding canals, which meander in every direction interminably through the flat lands, before they attain the outer edge of the delta. Through all of them, doubtless, some salmon pass, but three of the channels so far transcend the others in size and importance that for practical purposes they may be considered as forming the mouths of the Yukon and the main migration routes of the entering salmon. The channels in question, in order of importance, are Kwikluak Pass, or south mouth, with its important branch, the Kwiguk Pass; Kawanak and Kwipak Passes, which coalesce before entering the sea and form together the middle mouth; and Apoon Pass, or north mouth.

Much the smallest of the three is the Apoon Channel, which traverses the northern sector of the delta, and forms the most direct route for river steamers bound to and from St. Michael. Although exclusively used as a steamer channel, it is poorly adapted for this purpose, being so shallow both within and without the mouth that light-draft boats have quite the habit of going aground there and waiting until a favoring tide shall float them.

Few salmon apparently find their way through Apoon Pass. A few families of natives from Kotlik village had established a fish

camp on the shore just outside the mouth of the river, but the drying frames were scantily supplied with salmon when they were seen in the last week of July. Between the mouth of the pass and old Fort Hamilton no fishing stations were occupied, and the nets operated by the white trader at old Fort Hamilton were having no success. The general belief that Apoon Pass is of little importance as a fishway seemed wholly justified by observations. It has probably no greater importance than have some of the subsidiary channels through the delta.

The lower Kwipak and the Kawanak Passes, which together constitute the middle mouth, are the least known of the three main divisions of the river. No steamers traverse them and very few natives have their summer fishing camps along their banks. The Kawanak is a stream of large size and fair depth of water and the lower Kwipak, although choked with sandbars, carries a considerable current.

This middle mouth was visited July 5 to 7, at a time when the Carlisle Packing Co., on request, was testing the run of salmon by setting nets in the lower Kawanak Channel. Two nets were set along the left bank and two others were set offshore along the edge of a bank. This test was made during a slack period in the run in the south mouth, when the king salmon especially were running in greatly reduced numbers and the chums were not coming in full force. During 14 hours' fishing in the Kawanak Channel the four nets took 3 king salmon and 67 chums. In a second test of equal length the following day the showing was even less favorable.

One native fishing camp, which obviously has been occupied for many years, is located on the upper point of the long island which separates the Kawanak and Kwipak channels, immediately below their first confluence near the mouth. Four families were encamped at this place, and reported a favorable catch of king salmon during the preceding two weeks. The run had now slackened, they said, and the chums were just beginning to appear. They had found the season thus far very much better than the preceding year, when they had fished in the same locality. During the season of 1919 they had been unable to secure many more salmon than they had needed for their summer's use. At the time the camp was visited they had caught enough king salmon to fill one rack and two smokehouses, and had made use of two short gill nets of their own make set in an eddy along the bank of the island. The nets were not more than 25 feet long. Later, when a fresh run had entered the south mouth, word was received that the native fishermen in the middle mouth were again making good catches. It seemed, therefore, that the runs in the two mouths were well synchronized, the fluctuations during different seasons and between different days of the same season, following each other closely. This was well shown in a test made in the middle mouth, on request, during the earlier part of the season, when king salmon were running abundantly in the south mouth. This test was made on June 25 and 26, and resulted in a satisfactory catch of king salmon, with very few chums.

In view of the tests here indicated and observations at the fishing camp, it can not be said that the middle mouth lacks importance as a route for salmon. Yet it is considered to be very far indeed behind the south mouth in this respect. It is doubtful whether it equals in

importance the subsidiary channel known as the Kwiguk, which branches off from the Kwikluak Pass, a few miles above its mouth. It may safely be inferred that the native fish camps are located at the most favorable fishing sites. These are occupied year after year and generation after generation by the same families and their descendants. Where native fishing villages are most thickly grouped will be found the largest and most unfailing supply of salmon. With this as a basis, the writers are compelled to conclude that the south mouth serves as the migration route for the greater part of the Yukon run. While no data are available for an estimate, it is not considered beyond the bounds of probability that nine-tenths of the entire run enter by the Kwikluak Pass and its subsidiary channel, the Kwiguk. About 100 families of natives were fishing in this district in 1920, while not to exceed 10 families were seen in the middle mouth below Dogfish Village. In no case did the latter families have equal success with those camped on the Kwikluak Pass.

It is on the Kwiguk Channel, just below its emergence from the Kwikluak, that the floating cannery of the Carlisle Packing Co. has been located during the two seasons of its operation in the delta. Protected from the heavy southerly winds which blow up the main channel during the summer months, this site is within easy distance of the main fishing grounds in the lower part of the Kwikluak Channel and among the offshore shoals and islands. Inasmuch as the Yukon salmon appear largely to travel along the banks, in the eddies, and along the margins of submerged banks, it is believed possible during a favorable fishing season to secure from this location as a base a very considerable proportion of the salmon of the Kwikluak Channel. Fortunately, no commercial fishing for export is permitted in the Kwiguk Channel. Several native families were located on this channel in 1920, and one white trader maintained a wheel. Good catches of king salmon and chums were secured at all of these camps, but it was believed that the run of kings was proportionally not as heavy as in the main channel.

COMMERCIAL FISHERY OPERATIONS IN YUKON DELTA IN 1920.

The fishery operations of the Carlisle Packing Co. in 1920 were conducted principally in the south or Kwikluak mouth of the river and beyond that mouth among the seaward channels which diverge from it. The mouth of the Kwikluak Channel was designated as it was during the previous season by a stake set in the right or northern bank on the projecting point of land at Ingrakalak (see U. S. C. & G. S. chart 9373) and by a stake set on the left or southern bank of the channel at the entrance to the well-marked lagoon some half mile below Nilak.

A few fishing camps were established by the company as far up the Kwikluak Channel as Dogfish Village, where the main river makes its first grand division into the Kwikluak Channel and a channel which later divides to reach the middle and the Apoon mouths. Above Dogfish Village no fishing camps were established by the company, but they purchased limited numbers of salmon from a few independent fishermen, who operated at points below the mouth of Clear River near Andreafski.

Commercial fishing for export was thus carried on exclusively in the main Yukon, between the mouth of Clear River and Dogfish Village and below Dogfish Village, in the main Kwikluak Channel and its seaward extensions. All subsidiary channels branching off from the Kwikluak were closed to commercial fishing, whether these served as communicating links between larger channels, as in the case of Aproka Pass, or, as in the case of the Kwiguk Channel, secured independent egress to the sea.

But in no case were the salmon which entered through these protected channels given unimpeded access to the upper river. All of them must pass through the 40 or 50 mile stretch of the main river between Dogfish Village and Andreafski, where they were exposed to capture for commercial purposes; and those that enter through the important Kwiguk Channel must in addition run the gauntlet of a further 40 miles of river between the Kwiguk entrance and Dogfish Village. During the past season very little commercial fishing was in fact carried on in the stretch of river above Dogfish Village, but this was of choice and not from necessity, for no restrictions are there imposed by existing regulations.

During the season of 1919, 65 per cent of the king salmon and 61 per cent of the smaller fish—chums, cohos, and sockeyes—were taken beyond the mouth of the river, while in 1920 the proportion was even greater, 69 per cent of the king salmon and 68 per cent of the chums being taken outside.

The fishing grounds in 1920 extended much farther away from the river than in 1919. During a part of the season 12 fishing boats were located between 10 and 20 miles outside Nilak, along the shallow banks bordering the Acharon Channel on the mainland side (U. S. C. & G. S. chart 9373). The outermost stations were for a time the most successful, meeting the Yukon salmon well down the coast toward the mouth of Black River. How much farther in the direction of the Kuskokwim the advancing schools may be encountered in numbers adequate to warrant commercial fishing is as yet undetermined. An expedition which they sent down the coast to Cape Romanof testifies to the interest of the Carlisle Packing Co. in this question.

The fishing methods employed by the company in 1920 did not differ from those in use in 1919. Almost their sole dependence was on gill nets, set in convenient lengths in the eddies and on shallow banks along the main channels. For the most part these were set nets or anchored gill nets, with one end made fast to the shore and the outer end anchored. But during the latter end of the season, when the river was no longer at flood, it became possible to fish on shallow banks, which were not available during the height of the king salmon run. Stake nets were then used in larger numbers and would unquestionably have been availed of more extensively throughout the season had the stage of water permitted.

The gill nets used were of two kinds, the king salmon nets of 84-inch mesh and the nets for chums and other small salmon of 54-inch mesh. As the company from the beginning of the season contemplated fishing largely, if not exclusively, for the king salmon, only nets of the larger mesh were issued during the height of the king salmon run, which lasted up to the last days of June. After this

date the smaller mesh nets were also issued, but the number of these on hand was not adequate to supply all the fishermen.

Forty-one boats in all were employed in fishing, 34 of these throughout the season, the remainder for varying periods. Four of them were engaged so short a time and obtained so few fish that they may well be omitted from consideration. To each boat was issued 200 fathoms of king salmon net, and subsequently 200 fathoms of the small mesh salmon net, to the extent that this was obtainable.

In addition to the gill nets, renewed attempts were made in 1920 to use fish wheels. Two of these were constructed by the company, but were no sooner placed for fishing than they were put out of commission by the heavy drift which was running during the early days of the fishing season.

In addition to the above, nine wheels were privately owned and operated within the area open to commercial fishing, and the catch of seven of these was sold in whole or in part to the cannery. A very limited number of salmon were obtained from independent fishermen using nets. The number thus purchased from independent operators using wheels or nets amounted to some 7,400 kings and 27,000 chums, out of a total number handled by the cannery of 58,467 kings and 155,655 chums.

The fishing gear operated by the cannery and by private parties occupied only a narrow fringe along the margins of the channels. No attempt was made to fence or block the main channels in any manner, nor could such an attempt at any time be successful.

The employees at the cannery numbered 254. Of these, 122 were brought in from Seattle, including 40 Orientals and 44 fishermen. Of the 132 Alaskans, 40 were employed as fishermen, while 48 were natives, of which the first crew of 25 ceased work in the middle of the season. It was pleasing to learn from the superintendent that the Alaskan fishermen gave a good account of themselves and would hereafter be preferred by the company.

The pack put up by the cannery in 1920 was far less extensive than in the previous year, as is shown by the following table:

PACK OF SALMON BY YUKON CANNERY IN 1919 AND 1920.

Product.	1919	1920
Canned (cases):		
King salmon.....	28, 582	15, 934
Chums.....	24, 543	12, 819
Cohos.....	3, 181	0
Reds.....	28	5
Mild-cure (tierces).....		145

The comparative lack of success in 1920 was due in part to the unfavorable fishing conditions and in part to voluntary shortening of the fishing season. In 1919 fishing was continued until the close of August, but in 1920 only until the middle of July, as the low market price for chums did not warrant the company in continuing to operate after the run of king salmon was over. The season of 1920 was extremely late on the Yukon, and the king salmon entered with a rush, while yet the river was very high and was carrying down enor-

mous quantities of drift, which clogged the nets and rendered them inefficient. Also, during July the weather was unusually stormy, interfering with the fishing and endangering both fishing gear and the lives of the fishermen exposed on the flats beyond the river's mouth. From the cannery standpoint, the season was a failure, redeemed from actual loss—if such indeed was the case—by the extremely high price quoted this year for king salmon. Yet the cannery pack of 28,758 cases fell short only 1,242 cases of the maximum number of salmon which had been designated by the Secretary of Commerce as safely to be spared for commercial purposes from the Yukon River run.

No fish intended for export from Alaska were salted on the Yukon River in 1920.

SUPPLY OF DRIED SALMON PREPARED ON YUKON RIVER IN 1920.

On the voyage down the Yukon from Lower Lebarge to the delta, following close behind the running ice, May 24 to June 13, few indications could be observed of preparation for the fishing season. Here and there a white fisherman was engaged in constructing his fish wheel in time for the short king salmon run, but the native fish camps were unoccupied. Later it was evident that in comparatively few instances did the natives have wheels in the water in time to obtain any considerable number of king salmon.

On the lower river, below Holy Cross or Paimiut, the natives belong to the Innuited stock, and fish much less extensively with wheels than do the Indians of the upper river. They employ for the most part short lengths of homemade gill nets, which they set in eddies behind projecting points of the shore. As favorable localities are found almost exclusively along the high right (north) bank of the lower river, the fishing villages are confined to that side.

Above Holy Cross the use of nets becomes less and less an important factor, and wheels are relied on almost exclusively for the capture of salmon. Rarely was the primitive fish trap or basket or the dip net seen in use. The small fish wheels, which seem to have been introduced on the Tanana River in 1904, have been generally adopted on the upper river by whites and natives alike. They cost about \$50 each, in addition to the labor of building them, and are wonderfully effective when skillfully placed.

In the section of the river between Holy Cross and Rampart little dependence is placed by the natives on the king salmon. There is an early short run, and the natives are traditionally dilatory in making preparations. By the time their wheels are in the water the king salmon run is largely over. It is also true that the king salmon are more difficult to preserve, being larger in size and richer in oil. Those that are put up by the natives are kept largely for their own consumption and for this purpose are most highly prized. Taking the river as a whole, a distinct hardship is imposed on whites and natives alike when the king salmon run is below normal.

Unquestionably, however, the chum furnishes by far the larger share of the dried salmon. Along some stretches of the river almost complete dependence is placed on this species, locally known as the dog salmon and the "silvers." The higher grade of chums, known as "silvers," form the staple dog food throughout the Yukon country.

All the traders handle them and may deal in from 5 to 50 tons in a year. But they refuse to purchase dog salmon except as a last resort. The majority of the natives at the close of the fishing season sell a portion of their salmon supply to the trader with whom they deal, frequently leaving themselves without adequate provision for their families and their dogs. Later in the year they are often compelled to repurchase dried salmon at an advanced price, paying for it with the proceeds of their winter trapping. They are, of course, more or less improvident, as in the case of other primitive peoples. Their sale of salmon in the fall is frequently to liquidate their debts to traders who had extended them credit earlier in the season.

In the section of the main river below Rampart, where salmon are still rich in oil and the rainfall during the summer months is usually heavy, resort is had to smoking the salmon in order to preserve them. There is no commoner sight along the Yukon than the cluster of white tents in some picturesque nook among the hills of the right bank, and with them one or more high, barnlike smokehouses, which emit a faint blue vapor. There will be a fish wheel turning in the current along the rocky shore and a number of open-air racks, more or less protected from the weather, on which the salmon are hung for a time until partially dried and ready to be smoked. The picture is, of course, not complete without the native men, women, and children of the summer camp, nor without the invariable row of dogs closely tethered to stakes driven near the water's edge. Here the dogs fatten on the salmon heads and back bones and other refuse. They scratch out shallow holes to lie in alongside their stakes or burrow deep into the adjacent bank, if one be at hand, to escape the implacable swarm of mosquitoes.

Along the Tanana and the upper Yukon is a region of less rainfall, in which also the salmon have relatively dry meat, which is easily preserved. Here smoking is frequently dispensed with and dependence had entirely on air drying. But, by whatever method prepared, the fish of the upper river, of the Innoko, the Koyukuk, and the Tanana, are of inferior grade, and bring a lower price than do fish imported into these districts from the main river. The best product of all is secured from the Rampart Rapids. Here the "silvers" are said to average larger and fatter than in any other section. It is not improbable that inferior strains of dogs and "silvers" have turned into the lower tributaries, leaving at the rapids almost exclusively high-grade fish bound far up the river.

In the coastal district when salmon are running abundantly trenches are often dug in the soil by natives and hundreds of salmon are thrown in without preparation of any kind. They are then covered with earth and nature is permitted to have her unrestricted way with them. When the contents of these trenches are scooped out at some convenient season, perhaps in midwinter, they are said to make acceptable dog feed and to be not wholly shunned by the natives themselves.

The king salmon intended for their own food is often carefully prepared and stored away by natives of the lower river. When sufficiently dried and smoked, the sides are cut into pieces of convenient size and packed solidly in large baskets made for the purpose of woven grass, or willow roots, or frequently of salmon skins which

are neatly fitted together and sewed with sinew. The dog and "silver" salmon are tied in bundles weighing about 60 pounds and stored away in the caches in this shape. King salmon are also put in bundles on the upper river. Mention has been made of the salmon oil obtained as drippings from king salmon. In addition to this product, the eggs are very generally saved, being closely packed in any convenient receptacle, without special attempt at preservation.

During the early part of the king salmon run, from June 25 to July 1, a launch trip was made from Kwiguk to Holy Cross and return for the purpose of inspecting the condition of the salmon racks and obtaining a clue to the extent of the king salmon run along the river. The run had been on in this district about one week, and all the fish racks along the river contained considerable numbers of king salmon. The opinion was general that the season was opening favorably. It is in the delta and along this stretch of river that fishing is conducted largely with short lengths of gill nets set in eddies, and in this district the run of king salmon is a very important factor in providing the winter's supply of food.

In addition to the native camps, there are numerous fishing stations occupied by white men. Many of these men are married to native women, and some of them are found in native camps, dividing the proceeds with the native families. In such cases we observed commonly that the efficiency of the camp was increased. The white men operating on the largest scale were usually holders of winter mail contracts, which necessitated the use of large numbers of dogs. One such mail carrier keeps some 60 dogs and requires annually for their feed from 12 to 14 tons of dried salmon. As these are exclusively dog or "silver" salmon, the number used is between 15,000 and 20,000.

Other white men take dogs to board during the summer and sell all salmon they are able to put up beyond their own needs. Many of the more intelligent natives now count on doing the same. There is a wide and legitimate demand for dried salmon, for use during the winter season when all travel in the interior of Alaska must be by dog team. As it is impossible to carry enough salmon for a long journey, all "dog mushers" depend on the country they pass through. The road houses maintain a supply for this purpose, the dried salmon taking the place of hay and grain in regions where horses are employed, and being equally indispensable.

During the month of August and the first 10 days of September the Yukon was traversed from the delta to Dawson and the Tanana as far upstream as Nenana, traveling in a launch and calling at the fish camps on the way. The number of families was ascertained as accurately as possible, the number of wheels engaged in fishing, and the total amount of dried salmon prepared for the season. In practically every native camp visited, one or more persons had a sufficient understanding of English to enable them to furnish the required information. In the majority of instances the racks, smoke-houses, and caches were inspected, and finally some facility was acquired in verifying by observation the estimates furnished.

By this method the writers are enabled to present an estimate of the dried salmon prepared on the Yukon in 1920, which is based on

more extended data than any heretofore furnished, and it is an understatement of the amount of salmon actually cured and used on the river is obvious from the following considerations:

1. The lower river was canvassed from the 1st to the 15th of August, and there was a later run of "silvers" of limited extent, of which the figures give no account. A message from Holy Cross, dated September 15, indicated a medium run of "silvers" for some three weeks after that point was passed. The still later run of cohos is also not included in the estimates.

2. No clue could be obtained as to the number of salmon eaten fresh during the season, but this must be a considerable item.

3. None of the tributaries of the Yukon were visited, with the exception of the Tanana below Nenana, yet some of these, like the Innoko, the Koyukuk, the Porcupine, and the Stewart, are important streams. The natives in these regions draw on the rivers for their supply of dried salmon, and the white prospectors and miners out on the creeks may obtain their dog feed from the very spawning beds. To what extent spawning beds are invaded for this purpose is not known, but from reports that have been received it would seem probable the figures may reach dimensions of some local importance.

On the Yukon River, from the mouth to Dawson, 97 native fish camps were observed, each of which contained from 1 to 15 families. Three hundred and seventy families were listed, who were engaged in fishing, but the matter was sometimes obscure and the number of families may have been somewhat greater than this. The natives operated 166 wheels, in addition to the short gill nets of the lower river, which were not enumerated. The dried salmon put up by them amounted approximately to 350 tons, or nearly 1 ton to each known family. Many families had less than this amount, but others compensated for the deficiency by harvests of 3, 4, or even 5 tons. The younger generation gives promise of being more provident than the old. Some of them put up large surplus stocks for sale and carry over fish from one season to the next. There is some apparently well-founded complaint that sufficient care is not always given to curing the salmon, so that in rainy seasons like 1920 large stocks may be offered for sale which are rendered almost worthless by mold and decay. One Japanese fisherman operated a wheel on the river and put up 1,200 pounds.

There were 76 white fishing camps, usually with a single white man in a camp, but in a few instances two white men were working in partnership, or a white man in conjunction with natives. There were 91 white men in all, and they prepared approximately 190 tons of dried fish.

On the Tanana River below Fairbanks there were 24 native fishing camps, operating 24 fish wheels and containing approximately 30 tons of salmon. There were also 26 white fishing camps, with 34 wheels and some 52 tons of salmon.

Altogether, on the Yukon and the Tanana, 301 fish wheels were operated in 1920 and resulted in a take of 622 tons. Of this amount 8 per cent were king salmon and 92 per cent were chums. If an allowance of 100 tons is made for the tributaries not visited and for the later runs on the Yukon which were not seen—and this allowance

is almost certainly inadequate—there would be a total provision of dried salmon for the Yukon and its tributaries in 1920 amounting to 722 tons.

The only previous estimate known, based on a partial canvass of the fishing camps, was that prepared by Messrs. H. J. Christoffers and C. F. Townsend, of the Bureau of Fisheries, in 1918 for the purpose of the Yukon hearing of that year. They enumerated 393 fish wheels and a total product of 650 to 700 tons for the Yukon and Tanana Rivers, exclusive of Yukon Territory. Mr. Volney Richmond, manager of the Northern Commercial Co. stores, basing his estimate on conditions throughout the Yukon Valley, intimately known by him for many years, gave 600 tons as a fair annual provision of dried salmon for the region. It is possible that more salmon were dried in 1920 than would represent a fair average for the river, inasmuch as the previous year had been largely a failure, prices for dried salmon had risen to unheard of figures, and all reserve stocks had been exhausted.

Estimating the average dried king salmon at 5 pounds, and the average chum at $1\frac{1}{2}$ pounds, there were about 23,000 kings and 1,000,000 chums put up on the Yukon in 1920 for local use.

COMPARISON OF 1920 WITH 1919.

At all fish camps visited expressions of opinion were invited as to the relative size of the runs in 1920 and in 1919. The evidence given was overwhelmingly in favor of the run of 1919 being considered one of the worst if not the very worst ever known on the Yukon. Natives and whites all were practically a unit in this belief. Those who believed the cannery was not responsible for the shortage were as well satisfied on the subject of the shortage itself as were those who laid the entire responsibility at the door of the cannery. Those who did put up fairly satisfactory supplies of salmon recognized that they were especially favored in their locations, but thought that the river as a whole was relatively bare of fish.

In the lower section of the river more fish would have been prepared if storms had not broken the wheels and interrupted the fishing. Storms also broke wheels and interrupted fishing along this section of the river in 1920, but racks and smokehouses were not empty of fish. The natives about Nulato and Koyukuk would have made better provision for the winter of 1919 had they fished diligently throughout the season instead of potlatching as they did. They would unquestionably have had more fish, but it is doubtful whether they could have secured enough even had they fished consistently with as much diligence as they ever display. It was impossible to doubt, after interviewing several hundred people distributed along the entire length of the Yukon, that the run of 1919 was phenomenally deficient; and, furthermore, that if this condition should become permanent, or should frequently recur, a very serious condition would arise in the interior of Alaska.

No basis is available for a well-founded estimate of the amount of dried salmon put up in 1919, but we believe that 150 or 200 tons would be an outside estimate for the entire river. The price rose to 25, 30, and 35 cents per pound, with no stocks available even at those prices. Men compelled to travel during the winter experienced

the utmost difficulty in securing substitute dog feed. Fresh meat was used, although this is by no means satisfactory, and deplorable numbers of caribou were slaughtered by natives and others for this purpose. Cereals and bacon were made use of, and stores and trading posts soon found their stocks running low. The natives killed, or permitted to die of starvation, half or more than half of their dogs, and many white men were compelled to adopt the same course. Undoubtedly the best dogs were retained and the least valuable were culled out of the teams. But the general opinion entertained by those best acquainted with the natives and their needs was to the effect that the great reduction in the size of their dog teams was disastrous and the dog shortage was sure to hamper them in their efforts to make a living during the coming winter.

There were no reported cases of starvation or of serious suffering among the natives during the winter of 1919 because of the shortage of salmon, although they might well have occurred in outlying districts if help had not been given by white traders and by others. At Tanana rations were issued from the military post at Fort Gibbon, intended to relieve distress among the sick and aged natives of that vicinity. But the winter was in some respects unusually favorable. On the upper river heavy snows drove the caribou to the lowlands near the river, where natives could hunt them without making long sledge journeys with their dog teams into the mountains. Commissioner Mackenzie at Dawson said that had it not been for this fortunate coincidence the Indians in that vicinity would have suffered severely. In the Tanana-Fairbanks district moose were abundant and were easily captured in the deep snows. And farther down the river, in the Nulato-Koyukuk region, the grouse, which had been scarce for a number of years, had begun to come back in their former abundance. Here again had the season not been unusually favorable for securing fresh meat near at hand severe suffering would have been experienced. Such favorable conditions can not be expected to recur should the salmon supply again fail.

To resume, it does not admit of doubt that there was a most serious scarcity of salmon last winter, nor that this was occasioned primarily by an equally serious shortage in the run. By no other theory can so general a failure in the river fishing be explained. The lower and middle sections of the river, the Ramparts and Upper Yukon, the Porcupine, the Tanana, and the Koyukuk, all tell the same story. Dogs were sacrificed in large numbers, which were neither useless nor superfluous, and the natives were saved from serious suffering only by a series of happy coincidences, which could not again be expected.

TO WHAT EXTENT WAS YUKON CANNERY RESPONSIBLE FOR 1919 SHORTAGE?

As the cannery of the Carlisle Packing Co. at the mouth of the Yukon did not operate prior to 1917, and as neither the king, chum, nor coho salmon matures in two-year cycles, it is evident that the cannery could have had no influence on the size of the run which presented itself at the mouth of the river in 1919 and sought access to the spawning beds. The individuals which comprised this run

had all been derived from eggs deposited in the Yukon gravels before ever the cannery was established. There could be no question, therefore of impairment of the run having resulted in 1919 from previous cannery operations.

The only possible effect of the Carlisle cannery up to the present time has been to diminish, by the number of salmon captured, the runs which enter the river and are available to the native and white inhabitants of the valley. In 1919 the company reported the capture of 101,107 king salmon and 357,081 small salmon, largely chums. If these had been captured upriver and dried, the king salmon would then have averaged about 5 pounds each and the chums $1\frac{1}{4}$ to $1\frac{1}{2}$ pounds. Adopting the lower figure, the cannery pack, dried, would have amounted to 252 tons of king salmon and 223 tons of the smaller varieties, or 475 tons altogether. This is held to be more than twice any possible estimate of the amount of dried salmon actually put up during that season on the entire river.

If the 100,000 kings and the 350,000 chums taken by the cannery had been permitted to ascend the river, to what extent, we may ask, would the situation have been helped? It would depend on the size of the run and the proportion which, under the conditions of 1919, would escape capture at the hands of the river fishermen. If the fishing camps along the river were catching 50 per cent of the run, the cannery fish would have added some 235 tons, and the catch would thus have been more than doubled. If they were capturing a third of the run, the cannery fish would have increased their small catch by over 150 tons.

Data for such an estimate are not available. In the muddy waters of the Yukon the schools of salmon are invisible, and no direct estimate can be formed of their numbers. There is abundant evidence, however, that a large majority of the king salmon running in 1919 were captured in nets or encountered nets and escaped from them on the way into the river. White fishermen and natives, practically without exception, including those who felt no hostility to the cannery, agreed that the king salmon averaged smaller in size than ever before and that the relatively few larger individuals were net marked in the majority of cases. The same fishermen, operating in the same localities in 1920, state almost without exception that the king salmon in 1920 averaged large in size, and the number of net-marked fish was so small as to be negligible.

Many opportunities have occurred to observe elsewhere salmon caught in wheels or traps above a district heavily fished with gill nets. The results are always the same. The smaller salmon filter through the nets, which screen out the larger sizes, leaving the average size of the escaping fish always greatly diminished. And many of the fish escape through the web after being temporarily captured, the twine having become so tightly constricted about the body as to leave permanent marks that can not be mistaken. At the rack which was maintained in Wood River above the Nushagak fishing district there was opportunity to examine the fish escaping from gill nets that were capturing from 75 to 90 per cent of the running fish, but never were the escaping sockeyes so extensively net marked as the Yukon king salmon are credibly reported to have been in 1919.

Not all the screening out of the larger sizes and the net marking was due to the operations of the cannery. Natives in the lower river also fish for king salmon with nets, but the extent of their operations is so very small compared with that of the cannery in 1919 that the effect was negligible. Fishermen interviewed stated that they had in previous years seen a few net-marked fish prior to the opening of the cannery, but never anything to compare with the condition observed in 1919. The prevalence of small-sized king salmon in 1919, taken in connection with the extent of the net marking, may justly be considered a measure of the closeness with which these salmon were fished in 1919.

What was true of the king salmon was true also, it is believed, of the run of chums. Fishing for these was prosecuted during the months of June, July, and August. Conditions at the mouth of the river were comparatively favorable for a maximum catch throughout the season. As the salmon move back and forth with the tides, passing up and down the banks where nets are staked, and loitering in the eddies where other nets are anchored, the cannery gear has repeated chances to ensnare them. One of the principal deficiencies in the 1919 run in the upper river was the almost total failure of the "silvers." These, it will be recalled, are the bright chums of high quality which run after the king salmon have passed. It was to these that the cannery devoted its attention after the king salmon nets had been retired. In 1919 the king salmon run had materially declined by July 5, and it was after this date that 272,717 out of the total 357,081 small salmon (principally chums) were taken. It is considered certain that the operations of the cannery in 1919 very materially added to the scarcity of fish on the river. Had the fish captured by the cannery been free to enter the river, the run would still have been below the normal size, but the distress and inconvenience occasioned to the interior of Alaska by the salmon shortage would have been largely mitigated.

EFFECT OF CANNERY IN 1920.

The run of 1920 has been universally approved by fishermen as the most favorable since 1916. Salmon were abundant, of good average size, and of excellent quality. Some fishermen acclaimed it the largest run they had ever seen on the river, but the majority called it a fair average run of the better class of years. Certain it was there was no necessary lack of dried salmon anywhere on the main river as far upstream as Dawson. Some complaint was heard of insufficient fish supply on the Yukon Flats in the vicinity of Fort Yukon, and it was noted in certain native villages between Circle and Forty-Mile that scant provision seemed to have been made for the winter. But it was not evident that there was any lack of salmon. All white fishermen and some natives in these districts made good catches and reported the fish abundant. At Dawson, where serious complaints were heard the previous year, sufficient supplies were secured in 1920. Such slackness as apparently existed in certain native camps may find its explanation perhaps partly in the effects of the "flu," which ravaged some of these communities in the spring of the year, partly in superabundance of money, owing to high prices received for muskrat pelts, and partly, in some com-

munities, to a general shiftlessness, which habitually leads to privation and suffering in the winter.

A similar condition was observed in certain fish camps on the lower Tanana, in which natives seemed obviously less intelligent and less efficient than in the great majority of camps on the main river. In a few of these was heard the complaint that there were no fish, but it is believed that their scant supply was due to other causes. It is of course true that any scarcity will first declare itself on the upper river and among the tributaries, after the salmon, which run in a single channel in the main river, have distributed themselves over a far wider area. It is regretted that reliable reports could not be obtained from the Innoko, the Koyukuk, and the Porcupine.

In comparing the effects of the cannery in 1920 with those in 1919 conditions are met in the two years that were the very reverse of one another.

In 1919 the total run of salmon was far below normal, the conditions for fishing at the mouth of the river were favorable, the cannery catch was very large, and considered in relation to the number of salmon running it was far larger.

In 1920 there was at least a fair average run of the better class, and not improbably it was one of the best runs that can be expected in the Yukon; but the cannery was unsuccessful, owing to adverse fishing conditions. It obtained little more than half as many kings as in 1919 and less than half as many chums. Had the 58,000 kings and 155,000 chums been permitted to enter the river more salmon undoubtedly would have reached the spawning grounds, but the amount of dried salmon would not have been greatly increased. In the first place the number released would bear a small ratio to the total number running in so good a year; and, furthermore, along that section of the river which put up by far the larger amount of dried salmon, wheels, if operated more than a few hours each day during the height of the run, caught more fish than could be cleaned and prepared for drying. It does not then appear that with a large run of salmon and a relatively small cannery pack the latter has any recognizable effect in lessening the dried salmon supply of the Yukon. We are not prepared, however, to venture the assertion that such would have been the case had the cannery pack in 1920 reached as large proportions as it attained in 1919. But even had the cannery put up the full 60,000 cases in 1920, for which it made preparations, it would not have reproduced the severe conditions which existed on the river in 1919. These, as has been shown, were the result of a phenomenally poor season, made much worse by a large cannery pack.

GENERAL DISCUSSION AND RECOMMENDATIONS.

The dependence of the native and white population on the salmon supply of the Yukon admits of no question in the minds of any who have acquaintance with the conditions of life in the great interior of Alaska. The natives have other sources of food, but the salmon form their main provision for the winter—their insurance against starvation when other sources of food fail them, as they not infrequently do. No one who inquires into the matter can doubt that if

the supply of Yukon salmon should become seriously curtailed widespread suffering and death would in many seasons be visited on the natives.

The question of furnishing food for the whites is less urgent, but is not without importance. It was brought to our attention that with the price of all articles of food rapidly rising, while wages in the interior of Alaska have shown practically no increase during recent years, the presence of a cheap source of food is of value.

But one of the most important phases of the salmon question, which concerns whites and natives alike, is in relation to the dog. The whole scheme of things in the sparsely populated Yukon wilderness is predicated on the dog, and the use of the dog necessitates dried salmon. The winter is the only time for travel except along the waterways of Alaska, and winter travel is impossible without the dog team. Dogs are equally indispensable as draft animals and pack animals. Transportation of the winter mails over thousands of miles of the interior of Alaska must be accomplished by dog team. Men of the Army and the Signal Corps, like all other people in Alaska, are dependent on the dog whenever business makes it necessary for them to undertake winter travel. Fort Gibbon alone needs 40 tons of dried salmon each year to feed the dogs that they find indispensable in their work. Prospectors need them to carry their supplies into the hills. Wood choppers require them to haul in the wood. Indians must have them on their long hunting and trapping expeditions, and without them can neither secure meat for their families nor furs to exchange for the other necessities of life.

The dog is as essential in Alaska as is the horse in other regions, and the only acceptable dog feed is dried salmon. Various substitutes have been tried out when salmon could not be procured. They were used extensively by the "dog-mushers" of 1919, when dried salmon often could not be had at any price. Fresh meat was used, and enormous numbers of caribou and moose were slaughtered for this purpose. But it is impossible to carry sufficient meat for many days, and the supply is precarious. Furthermore, the dogs do not thrive and work well on this diet. A diet of cereals and fat in some form was extensively used. Stocks of rice, flour, corn meal, and bacon were heavily drawn on. Dogs traveled well on a ration of corn meal and bacon, but the expense was almost prohibitive, and there was the labor of cooking up each night in camp a meal for the dogs after the exhausting travel of the day with the temperature perhaps 50° below zero and a weary famished team waiting to be fed. Dried salmon forms a light condensed food which contains all the elements needed to keep a hard-working team in excellent condition, and it is always ready to be fed without preparation. There is no acceptable substitute, and there is not in Alaska any divergence of opinion on this subject. No single need in the interior of Alaska is more generally or more urgently felt than dried salmon for its various uses.

It is clear, then, that the Yukon and the Kuskokwim offer salmon problems which are not pressing on any other Alaskan rivers with the exception of the Copper River. These streams drain the far northern interior districts of Alaska with long severe winters and the briefest of summers. The inhabitants are few in number and are distributed widely over a wilderness which is largely without

population. Their lives are subject to the most severe conditions of existence. Largely they are dependent on the resources of the country. To deprive these people of one of their most valued and most important resources would seem under such circumstances peculiarly indefensible. The principle should be adopted with regard to the interior rivers of Alaska that no commercial interests should be permitted to exploit them until it should be demonstrated that a portion of their salmon run could be spared without detriment to the run itself and without encroaching on the supply needed by the populations that inhabit the valleys of these rivers. And if there is any question whether the salmon run in a given stream is adequate to supply the demands of commercial operations as well as the needs of the inhabitants, the doubt should at once be resolved in favor of the people. The subject should not be one for experiment. Canneries should not be permitted to establish themselves on these streams while we calmly await the result. They may create havoc before the evidence thereof is clearly shown, and in the meantime they will have secured those highly prized "vested rights" which make their position difficult of attack.

A floating cannery operated by the Carlisle Packing Co. is already established at the mouth of the Yukon, and it becomes appropriate to inquire whether the continued operation of this cannery is compatible with the best interests of the Yukon Valley. It is evident that if the fish required by this company can without question be safely spared, the cannery should be welcomed, for it provides much needed freight for a transportation company that supplies the Yukon and it offers much needed employment for a limited number of natives and others during a brief period of the summer. But if the operation of the cannery should threaten encroachment on the supply of salmon needed in the interior it should be compelled to close, as no advantage to its few employees could possibly compensate for widespread inconvenience, distress, and suffering.

As a result of the Yukon hearing, given in Seattle, Wash., November 20, 1918, the Secretary of Commerce promulgated an order that limited the pack of canned salmon to 30,000 cases in any year from the Yukon River, embracing all waters of its delta to and including the area 500 yards outside each mouth or slough of the delta at mean high tide. Beyond this area of 500 yards outside the mouth or mouths of the river the Secretary of Commerce exercises no jurisdiction, the Congress having failed to confer it upon him. He is therefore helpless to extend protection to channels between shoals and islands off the mouth of any river, although such channels may be regular migration routes of the salmon bound for that river and as much open to attack as any part of the river channels.

Realizing this deficiency of the laws, the Carlisle Packing Co. in 1919 put up approximately the maximum pack inside the river, and then proceeded nearly to double this with salmon equally bound for the Yukon which they captured outside the mouth of the river. In doing this they were wholly within their legal rights, but they evinced thereby an indifference to the obvious purport of the order, which was to provide for a strictly limited pack of Yukon fish. In making this increased pack they happened on a year when the run was poor and the fishing conditions were excellent. They were

enabled, therefore, to give a demonstration of the results of such operations when these two conditions appear in conjunction. The disastrous year of 1919 resulted.

As to the future, there is no assurance of better protection than in 1919. From our inquiries it appears that the Yukon runs of salmon are by no means uniform in size. Good years and poor years alternate, and occasional very poor years have always appeared. Meanwhile the Carlisle company continues to operate without check beyond the mouth of the river. Should they consider the prospect of success warranted the expenditure, there is nothing to prevent their increasing the number of fishermen and preparing for a pack of 100,000 instead of 60,000 cases. Or one or more other companies may join in the business of catching Yukon salmon off the mouth of the river if they consider the venture a promising one. The Yukon run is wholly without adequate protection as long as the approaches to the river are open to unrestricted fishing and are outside the jurisdiction of the Secretary of Commerce.

Finally, it is the judgment of the writers that the Yukon River salmon run is not to be relied on annually to produce a surplus for export in addition to the supply needed for local requirements and the further quantity essential for propagation. During good years a surplus might be spared sufficient to produce a limited pack, but during poor years the operation of a cannery will have the effect of making a bad situation very decidedly worse.

It is recommended, therefore, that all commercial fishing for export be prohibited in the Yukon River and its tributaries, including the waters of the delta and an area 500 yards outside the mouth of each channel or slough of the delta.

Furthermore, it is recommended that immediate steps be taken to have brought within the jurisdiction of the Secretary of Commerce all those channels between the shoals and islands which form the approaches to the Yukon in order that commercial fishing in said channels for export may be effectively limited or entirely prohibited.



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DEPARTMENT OF COMMERCE
BUREAU OF FISHERIES
HUGH M. SMITH, Commissioner

DANGER TO FISHERIES FROM OIL AND TAR POLLUTION OF WATERS

By J. S. GUTSELL
Scientific Assistant, U. S. Bureau of Fisheries

APPENDIX VII TO THE REPORT OF THE U. S. COMMISSIONER
OF FISHERIES FOR 1921



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DANGER TO FISHERIES FROM OIL AND TAR POLLUTION OF WATERS.¹

By J. S. GUTSELL,

Scientific Assistant, U. S. Bureau of Fisheries.

Recently the casting of oil on already sorely troubled waters has increased at such a rate, has been accused as the source of so many ills of fishermen and shell fishermen and even of ornithologists, and has become such an obvious nuisance, that a considerable realization of the extent of the contamination and a sense of the possible evil effects have been aroused. So great is the discharge of oils of various sorts that in this country it has been proposed to skim off the oil from some harbor waters and make it available by proper treatment. In Switzerland a patent has been taken out for the recovery of oils from backwaters. It is very desirable, therefore, to present a brief review of the information available regarding the extent and nature of oil and oil-like pollutions with consideration of the possibilities of danger therefrom.

SOURCES OF POLLUTION.

Danger of fatal contamination from the poisonous substances seems to lie chiefly in the gas plants and petroleum distilleries, which on one occasion or another, if not regularly, find it convenient to let certain products drain into the nearest body of water; in tankers and oil-engined craft, which are able to use tar, tar oils, and a great variety of petroleum distillates; in oil-burning steamships; and in the washings of oils and tars from roads.

Gas houses and oil refineries are located on all sorts of bodies of water larger than brooks. In smaller streams, and particularly in those inhabited by salmonids, discharges are doubtless frequently fatal to fish life and quite ruinous to the fish value of the water. In larger bodies the actual destruction of fish is apt to be small or incident to exceptional discharges, and the chief harm probably will come from the uninhabitability of the water, especially if this means the rendering unfit of a spawning ground or the forming of a barrier thereto as for salmon or shad.

In streams large enough for steamers, and in all larger bodies of water, there are added to the contributions from gas houses and refineries those from tankers and other ships, and the dangers to fishes from poisoning or coating of gills are correspondingly increased. These larger navigable bodies may be spawning grounds and are almost sure to be gateways to what should be spawning grounds. The danger here, therefore, of keeping fish away from the spawning

¹ Appendix VII to the Report of the U. S. Commissioner of Fisheries for 1921. B. F. Doc. 910.

grounds is far greater than the danger of destruction. It has been charged, but apparently not specifically established, that fish in harbors and the lower stretches of rivers have been killed by the dumping of oil from tankers. All of these vessels must clean out their tanks before they refill them and are prone to do so in harbor or as near there as may be.

Well out at sea and in the larger bays the only source of considerable oil pollution seems to lie in the shipping, which, if it can not discharge in or near harbors, will do so at sea. Moreover, it seems clearly established that great oil films do form at sea. Huge patches have frequently been observed, and Collinge reports that sea birds have been found dead and dying by hundreds off the English coast, their feathers saturated with oil. Death of sea birds from the same cause is reported from our Pacific coast.

Tar from freshly tarred roads may be washed bodily into gutters and thence into streams or other bodies of water. Apparently, however, the greatest danger of direct action from tarred roads is from the fact that under the various influences at work—presumably heat, the mechanical action of vehicles, and soluble action of oils—poisonous substances are yielded to road washings for a great length of time. Various people in England, as recorded especially in the (London) Fishing Gazette, have described instances or experiments which indicate the continued poisonous action of tarred roads. Richmond found that although an undisturbed tarred surface became innocuous in three weeks, washings from material chipped from a road which had not been tarred for approximately one year were fatal to fish. Tarred road washings appear to be noticeably destructive of fish and, largely through the destruction of food organisms, of fisheries, chiefly in streams not larger than small rivers and ponds, particularly trout waters. In well-developed country so fortunate as to possess salmon streams, tarred roads doubtless constitute a menace to the salmon fishery.

Oil from motor cars, etc., goes into small as well as large bodies of water and is of greatest volume at large towns.

EFFECTS OF OIL POLLUTION.

Oil remains in part as a surface film on the water, and is probably in part emulsified and distributed in intermediate strata, while the heavier fractions are deposited on the bottom, where they persist for a long time. All parts are washed ashore to be deposited on the beaches and vegetation between tide marks.

This pollution may affect the fisheries in various ways: By actually killing or repelling the fish when they approach the shores in their migrations, at the only time when they can be caught; by sickening or killing bottom-dwelling species such as oysters; by killing floating eggs and the delicate larvæ which, swimming at or near the surface, are suffocated by the deposit of an impervious film on the gill surface; by destroying the minute surface plants and animals on which these larvæ and some of the adult fishes subsist; by diminishing the aeration of the water at the surface and thereby aggravating the deoxidizing effects of organic pollutions from municipal sewage and similar sources; by destroying spawning grounds; by killing the

shallow water vegetation which directly or indirectly furnishes fish food and shelter; and by impairment of the market value of fish through imparting to them an offensive taste.

DIRECT TOXIC EFFECTS.

A great variety of tars and tar oils, either from coal or petroleum, have been shown to be highly poisonous. Butterfield and writers in the (London) Fishing Gazette and the Salmon and Trout Magazine, and Shelford and Thomas in this country (see bibliography) have reported various experiments which show that tar and tar oils are poisonous in great dilutions. Tars or tar oils result from distillations of coal, petroleum, woods, etc. These distillation products are very complex and varying in composition, but all may be assumed to contain some of the substances which, in very weak dilutions, have been shown to be highly poisonous to various fishes. Phenols and cresols (in dilutions of less than 100 parts per million) have been found quickly fatal by Butterfield and Shelford. Other constituents which are quickly fatal in the dilutions indicated are phenanthrene and naphthalene (4 to 5 parts per million); xylene, toluene, benzene, and ethylene (22 to 65 parts per million); sulphur compounds, as hydrogen sulphide (5 parts per million), sulphur dioxide (16 parts per million); carbon bisulphide (100 parts per million); thiophene (27 parts per million); ammonia (7 parts per million); and ammonium salts and other nitrogenized compounds (some hundred parts per million); quinoline and isoquinoline (50 to 65 parts per million). The strengths given as quickly fatal are those which have caused death in one hour, or very little more, to sunfish (American) or gudgeon (European), fish which seem more than ordinarily resistant to poisons. It is stated (Seydel) that Russian investigators find hexahydrobenzoic acid ($C_6H_{11}CO.CH$), to be the essential poison of Russian petroleum, and that 4 to 16 parts per million were quickly fatal to a cyprinid and a percid.

The experiments of Thomas and others indicate that prolonged exposure to very much greater dilutions of these substances are fatal. Dilutions of various tars and crude distillates of petroleum, which required 66 or more parts per million for quick fatality, have proved fatal in strengths of from 13 to 33 parts per million in from 1 to 3 days. A great variety at 13 parts per million proved fatal in 3 days. One liquid tar waste at 2 parts per million killed sunfish (*Lepomis humilis*) in one day.

MECHANICAL EFFECTS.

Certain petroleum products appear to contain no poisonous substances soluble in water and to have little direct effect when allowed to form a surface film, but when emulsified by agitation prove deadly. A high-boiling petroleum distillate and a light fuel oil were found by Thomas to be quite harmless, unless as aeration retarders, or unless emulsified, as by continued moderate agitation, when they coated the gill membranes of the fish and caused death by suffocation. Rushton found that by shaking up 1 part of benzine with 40,000 parts of water, a mixture was formed which killed fish in five minutes, apparently entirely from poisonous action.

Doubtless under the agitation of continued wave action many, if not all, oils and oily substances will emulsify or mix to a considerable extent and so coat the gills of fish or other forms, or have a poisonous effect which their insolubility would otherwise prevent. According to Weigelt, ulcerations and attacks of disease have been found to follow the irritating action of petroleum products.

The eggs of sea fishes which do not seek fresh, brackish, or shore waters in which to spawn differ from the eggs of all these and of fresh-water species in that they are typically floating. In many cases, at least, the larvæ for a time are also floating. This fact renders the possibility of grave danger to the great sea fisheries a very striking one, for it can scarcely be thought that eggs can hatch and young normally develop in a medium of oil. The eggs and larvæ of oysters and other shellfish are not surface floating, but are carried up and down by the current, sometimes to the surface. A special danger to them lies in the fact that both oil and larvæ (and eggs) are prone to collect in eddies.

PREVENTION OF AERATION OF THE WATER.

The question of aeration prevention by an oil film is a very important one. Butterfield and Thomas have questioned considerable prevention, Butterfield on the supposition that mineral oil is similar to water in its oxygen absorption, and Thomas apparently on the theory that incomplete rather than complete films tend to form. There need be no question that extensive films do form. Furthermore it seems established by Adeney, especially in salt water and any water of considerable mineral content, that streaming, with the consequent distribution of the air saturated surface water, is largely dependent upon evaporation and increased density at the surface. If this is the case it must follow that an oil film, by preventing evaporation, greatly checks aeration. Danger from this seems chiefly to center in harbors where, because of general pollution, particularly sewage pollution, the oxygen consumption is greatest and where, because of gas plants and shipping and the great number of automobiles, the discharge of oil is also extreme. These are the same harbors which are the gateways to the great natural spawning areas of the anadromous fishes.

In connection with the prevention of aeration, oxygen loss by the absorption of dissolved oxygen, by fatty acids and other substances present in oils and tars, should be taken into consideration.

DESTRUCTION OF FISH FOOD.

Indirect action of oils and tars may consist of poisonous action on food organisms. Prawns appear very susceptible to tar poisons, and in English streams it has appeared that tarred road washings are even more destructive of insect life than of trout directly. It can scarcely be doubted that the susceptibility of minute forms is at least of the same order as that of fish. With a number of microscopic forms, particularly diatoms, it is known that their susceptibility to a number of poisons is greater than that of fish (Whipple, Moore, and Kellerman). Destruction may, of course, be secondary,

as from lack of oxygen, or from the destruction or spoiling of emergent or littoral vegetation with an oil coating, particularly in tidal areas (by which means wild fowls may also greatly suffer), and the consequent loss of a productive habitat.

From gas houses, tarred roads, and refineries much of the contamination eventually finds its way to the bottom to render it more or less sterile according to thickness and completeness of the deposit and the constancy with which the deposit is maintained. Wadham indicates that he found apparently complete strata for each fresh tarring of road, and that it took two or more years for a trout brook to recover proper productivity of fish.

In some waters the basic fish food consists in part of air-breathing larvæ and pupæ of insects, which, if a layer of oil is present, as is well known, will be unable to come to the surface to breathe and so will be destroyed. Young of food fishes or the small fish on which food fishes feed will in consequence be deprived of an important source of food, and the productivity of the region will be correspondingly decreased. In 1920, through the Gulf States, Mr. Hildebrand found that *Gambusia* and *Fundulus*, which feed largely on such larvæ and pupæ, disappeared from oil-covered water. He took no special notes in regard to larger species, but believed they disappeared also, presumably because their food had disappeared.

SUMMARY.

Three main sources of oil and tar pollution have been found: Road washings, carrying great quantities of lubricating oil; gas houses and oil refineries; tankers, oil burners, and oil-engined shipping. Tars, tar oils, and crude distillery products are found generally to be highly poisonous, whether in weak or great dilution. Some oils have been found to emulsify to a sufficient degree, with continued agitation, to coat the gills of fish and so produce death by suffocation. An oil film, through prevention or checking of aeration, is dangerous, particularly in busy harbors. The deleterious effect on spawning, by rendering spawning grounds unfit or inaccessible, is a grave danger arising from the pollution of harbors and streams. Another serious danger is found to lie in the possible effects on the diminution of the food supply. Through whatever means, it is an observed fact, according to Weigelt, that in Germany fish have completely disappeared from pools and ponds following the discharge of mineral oil into the water. In the sea a great danger is suggested by the fact that the eggs of sea fishes are typically floating, and that oil-burning and oil-engined shipping is greatly increasing.

Remedial measures may (now or in the future) be found: (1) In the recovery of oils from drainage water, as already has been proposed; (2) in the prevention of gas-house and refinery pollution, which prevention should be helped by the increased use of "wastes" in by-products; and (3) in prevention, by international arrangements, of the dumping of oil from ships in harbors or in the region of spawning grounds or special feeding areas.

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DEPARTMENT OF COMMERCE
BUREAU OF FISHERIES
HUGH M. SMITH, Commissioner

PROGRESS IN BIOLOGICAL INQUIRIES, 1921

**REPORT OF THE
DIVISION OF SCIENTIFIC INQUIRY FOR
THE FISCAL YEAR 1921**

By R. E. COKER
Assistant in Charge of Scientific Inquiry

**APPENDIX VIII TO THE REPORT OF THE U. S. COMMISSIONER
OF FISHERIES FOR 1921**



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REPORT OF THE DIVISION OF SCIENTIFIC INQUIRY FOR THE FISCAL YEAR 1921.¹

By R. E. COKER,²

Assistant in Charge of Scientific Inquiry.

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¹ Appendix VIII to the Report of the U. S. Commissioner of Fisheries for 1921. B. F. Doc. No. 911.

² With the collaboration of the investigators.

INTRODUCTION.

The fisheries industries are immediately confronted with such acute problems of distribution of products that it would seem only natural if attention were temporarily detracted from the underlying and enduring problems of the industry—those relating to maintenance of the resources upon which the industries are based. Nevertheless the discussions among representatives of all phases of the industry when gathered together in such meetings and conferences as have been held during the recent period of stress have always brought to the front the problems that have to do with the perpetuation of fishery resources. Such conditions as the depletion of shad, the decline of the blue-crab fishery, and the deterioration of inshore waters through pollution, command such earnest consideration on these occasions as to prove that fishermen and dealers of broad vision are not misled through immediate difficulties in one department of the industry to minimize the importance of permanent sources of supply.

Upon due thought, of course, it is evident that the problems of supply must not be forgotten even momentarily; for the difficulties of distribution can be only heightened by continued depletion of resources and an inevitably accompanying increase in costs of production relative to the costs in competing industries. Obviously it can not become easier to market fish when they become less easily obtainable relative to other materials of protein food. No economic fact can be plainer than that diminishing abundance of fish must be followed by increasing prices and decreasing consumption.

It is, then, a fundamental and enduring principle that the perpetuation of the fisheries and the maintenance of their relative rank among other food-producing industries are contingent upon the continued productiveness of the fisheries—in a word, upon conservation. Conservation in turn depends upon the exercise of intelligence and restraint in the exploitation of fisheries resources, upon sound action in removing unnecessary causes of depletion, and upon wisdom in adopting plans for bringing about where possible an increase of particular fish or shellfish. The decline of valuable fisheries has been witnessed too often to admit of continued faith in the inexhaustibility of fish or shellfish of any kind. Yet the intelligent determination of what restrictive measures are necessary, what means of exploitation are unreasonable, or what plans of propagation or development are profitable can be made only upon the foundation of full and correct knowledge of the life histories, habits, and conditions of life of the fish that are to be considered.

It seems generally agreed, for example, that the blue crab of the Chesapeake is in actual course of extermination by unwise fishery methods, although there may not yet be agreement as to the particular methods which are unwise. Recently this very important question was referred to a conference of representatives of the two States concerned, together with officers of the Department of Commerce. The practical results of such a conference depend much, of course, upon the sound practical judgment and the broad spirit of those bearing the responsibility for determination of action; but the one indispensable basis of action is an understanding of the life of the crab. The sole hope of practical results from a conference of any group of persons having this problem in view rests upon such

knowledge as we have of the life history of the crab—in short, upon the results of scientific work previously done. Emphasis must be put upon the adverb of time. The significant thing is that the work must in great part, at least, have been already done; for knowledge can not be secured immediately; one can not produce the life history of an aquatic animal upon demand; it is the result of painstaking study through a period of time which can not be fixed in advance, and by the application of methods which can not be definitely plotted beforehand.

It is work of this kind which must be done, and continuously done, so that gradually and steadily we learn more and more about our fishery animals, if we are to be ready at all times to meet the changing problems of regulation and exploitation as they arise.

The scientific knowledge which is the basis of the future welfare of the fisheries requires not only time and application, but also skill and special training. Of greatest importance are the services of men who have not only natural qualifications and the preliminary training which institutions of learning can give, but also such special experience, interest, and devotion as can be gained only as the result of prolonged application to fisheries studies. Something may be done with inexperienced and changing agents, but the most successful and economical work will be done with a trained and continuing force.

In the following report will be found not an account of what might have been done, or what ought to have been done—but rather a statement of the progress which has been attained under the difficult conditions by which the scientific work of the Bureau has been circumscribed. It may be added that the Bureau again closes the year with a less effective force than it had at the beginning. Two members of the already depleted staff have resigned to accept better paying positions elsewhere, and two (including one rendering largely volunteer service) have died and not been replaced. Special acknowledgments are due to those whose interest and loyalty have held them in the public service.

In reviewing the subject of investigation it must be understood that while the Bureau has a definite policy of restricting expenditures to investigations of the most direct practical bearing, it is not entirely untrammelled in the selection of subjects of investigation. The qualifications of the personnel available necessarily determine in part the character of problems which can be profitably attacked.

STUDIES OF FISHES.

THE PACIFIC SALMON.

When consideration is given to the magnitude of the industries based upon the salmons and their near relatives, to the unrivaled rank which some of these fishes hold in the realms of sport and recreation, to the comparative ease with which the more important species may be brought to virtual extermination, and to the fact that all important species are the subject of artificial propagation, it is apparent that no group of fishes demands a greater share of attention in the way of scientific study.

For many years investigations have been directed particularly at the Pacific salmon, and the facts of life histories which are easiest to secure have been acquired, but yet we are far from having possession of the full knowledge necessary to direct propagation most efficiently, or to determine correctly the restrictive measures which may be enforced with least interference with the proper utilization of the fishes. The problems before us now are those requiring the closest and most persistent study, and yielding solution only slowly and by small stages.

IMMATURE SALMON IN THE OCEAN.

The investigations of salmon in Pacific Coast States have been conducted by Willis H. Rich, special assistant. The study of salmon taken by troll and purse seine in the open ocean has practically been completed. A preliminary report was prepared and, by authority of this Bureau, was published by the California Fish and Game Commission. The conclusions reached may be briefly summarized.

The fish taken in the ocean off the mouth of the Columbia River contain, in the spring and early summer, approximately 70 per cent of individuals which will not become sexually mature for one or two years, but by the middle of August this condition has changed so that nearly 90 per cent are fish which will soon enter the river for the purpose of spawning. The rate at which this change takes place and the time at which it occurs have not yet been determined, but will be taken up in a later report. A comparatively small percentage of the fish found just within the mouth of the Columbia River are immature. It should be mentioned in this connection that it is only occasionally, when unusual tidal conditions obtain, that any immature fish are taken inside the mouth of the stream.

The fish taken by troll in Monterey Bay in June contain a considerable proportion of immature individuals. The data obtained in 1918 are most reliable and indicate that only about 40 per cent of the fish taken would have spawned during the same year. The data for 1915 indicate that 75 per cent were mature, but selection may well have taken place in making this collection which consisted of egg samples only.

The fish taken near Drakes Bay and Fort Bragg in July and August, 1918, contain approximately 30 per cent of immature fish. It is of interest to note that this is an approach to the conditions found off the mouth of the Columbia River in August and suggests that the composition of all the schools found near the coast changes materially during the summer season.

It is understood that the preliminary report was used to advantage in the recent movement restricting the operations of both trollers and purse seiners off the coasts of Oregon and Washington. Additional data will be embodied in a later report.

Incidental to the work with the fish taken in the ocean considerable data have been collected which will apply to the report dealing with the general life history of the chinook salmon. Progress has been made in the identification of races, and additional evidence from the scales of returned marked fish has confirmed the work done last year on the significance of the various types of nuclear growth.

RESULTS OF MARKING EXPERIMENTS.

Mr. Rich has also submitted a report on "Returns from the experiments on the marking of young chinook salmon on the Columbia River." The experiments were started in 1916-17 and described in Economic Circular No. 45.

The percentage of returns of marked salmon was rather low, but the results obtained are of some significance. Examination of the scales of the marked fish which have returned after a period of three to four years corroborates the theory that the arrangement of the concentric rings (circoli) provides an accurate record of the previous history of the fish. A study of the scales of these marked fish will, moreover, aid very materially in the solution of perplexing problems which have arisen in interpretation of the scales of the chinook salmon.

Facts gathered during the investigation throw some light upon the rate of spawning migration of adult chinooks, indicating that the rate is approximately the same as that previously determined for sockeye salmon passing through Puget Sound and the Fraser River, that is, some 10 to 15 miles per day.

Perhaps the most interesting and important contribution which these experiments have made to our knowledge of the biology of the salmon relates to the hereditary character of the factors determining the time of the year at which the adults enter fresh water and begin their upward migration to the spawning grounds. It is an important practical question whether or not it is necessary to breed from fish of the spring run in order to produce the spring-run fish, which are more desired than the fall-run fish. The evidence of the marking experiments gives some indication that spring-run fish will be derived from spring-run parents and fall-run fish from fall-run parents.

A comprehensive program of experiment has been planned to extend over a period of several years. Two new marking experiments have been started on the Columbia River in cooperation with the Oregon Fish and Game Commission, nearly 100,000 young chinooks having been marked at Little White Salmon station and the State hatchery at Bonneville.

SALMON INVESTIGATION IN YUKON RIVER.²

During 1920, from May until September, Prof. Charles H. Gilbert, temporary investigator, and Henry O'Malley, field assistant in charge of Pacific coast work, conducted an investigation in Yukon River with reference to the runs of salmon, the commercial packs in and near the mouths of the rivers, and the requirements of the natives and others dependent on the runs of salmon in the Yukon River system. Data were secured for a comparison of conditions prevailing in 1919 and 1920. The primary object was to determine whether or not commercial fishing for export should be allowed in the Yukon River and its tributaries.

While all five of the Pacific coast species of salmon make their appearance at the mouth of the Yukon, only three species have sub-

² Cooperative investigation by Divisions of Fish Culture, Alaska Fisheries, and Scientific Inquiry. Only the biological data are summarized here. The full report is published on pp. 128-154 in *Alaska Fishery and Fur-Seal Industries in 1920*, by Ward T. Bower, Appendix VI, Report of the U. S. Commissioner of Fisheries for 1921, B. F. Doc. No. 909.

stantial runs in the Yukon River (king, chum, and coho), and of these king and chum are of the greatest importance by far. The few reds or sockeyes taken near the mouth of the river are perhaps strays, for no breeding has yet been reported from any part of the Yukon Basin. Humpbacks appear at the mouth of the river more numerous than the red salmon, but never in sufficient numbers to constitute a run even of small dimensions. As they were far advanced toward spawning in July, it was evidently impossible that they could ascend the river far with their spawning period so close at hand. The coho runs more or less numerous than the king or chum salmon and in addition is the latest to appear, often not presenting itself in any numbers in the middle and upper reaches of the river until the ice is forming in the fall.

The king salmon begins running in the last week of May or the early days of June. The run culminates quickly and then almost as quickly declines. The rate of migration was found to be remarkably high, the average rate of travel from Tanana to Dawson being slightly less than 45 miles per day, and from Pilot station to Dawson, involving practically the entire length of the river below Dawson, the average rate was 57 miles per day. No record of any other river approaches this in completeness, nor in the high rate of travel indicated. This unexampled speed with which salmon ascend the Yukon is doubtless associated with the great distances to be traversed before reaching their upper spawning areas, taken in connection with the shortness of the summer season.

The most important natural enemies of the king salmon are the white whales, or belugas, and the lamprey eels, the former being undoubtedly exceedingly destructive, while the latter, though causing scars on the fish in much greater abundance than in any other river, as observed by investigators, do not appear to effect serious injury to the fish.

The chum salmon, which is the principal food product of the Yukon River, made its appearance but a few days later than the advent of the king salmon, the rate of migration being approximately the same as that of the king.

Two phases in the development of the chum salmon are distinguished by the natives under the names of "dog salmon" and "silver salmon," the dog salmon comprising the individuals furthest advanced toward spawning. In general the "dog salmon" along any stretch of the river consist of those individuals which will turn into some adjacent tributary to spawn, while the "silvers" are on their way to the upper reaches of the river, show relatively little of the sexual changes they will exhibit on their spawning beds, and are still richly provided with the oil which serves as fuel and the principal source of nourishment during the long journey still before them.

"Dogs" and "silvers" were in general keeping apart from each other and following distinct migration routes, the "dogs" predominating on the right and the "silvers" on the left side of the stream. Heavier runs of kings and cohos were found in company with the "silvers" along the left limit of the river. It appears, therefore, that there is a prevailing use of the left shore by those fish which are found in the upper reaches of the river. This may have

connection with the fact that the majority of the tributaries of the lower river enter on the right bank.

Fishermen recognize the succession of phases in the run—the chums which accompany the king salmon being of relatively small size and poor quality, after which there is a run of bright fish of good quality, but inferior size (“silvers”), and finally the last run of “silvers” of a bright rich form and of distinctly larger size. This last run of “silvers” is ordinarily of short duration and furnishes the most highly prized fish of the season. A further more detailed study of the characteristics of the chums at different times and in different localities and the distribution of the various strains to their respective spawning areas would offer results of importance from the biological and equally from the strictly practical points of view.

The investigators record their opinion that the king salmon of the Yukon is the richest in oil of any known king salmon, and express the same view with even greater emphasis regarding the Yukon chums. In this connection it is remarked that in other river basins the chums do not travel far from the sea, but enter late in the season to seek spawning beds not far inland, while the best of the Yukon chums travel 1,000 to 2,000 miles up a river known for its consistently rapid current.

Consideration was given to the passage through which the salmon enter the river, and the investigators considered it not beyond the bounds of probability that nine-tenths of the salmon run enter by the Kwikluak Pass and its subsidiary channel, the Kwiguk.

CHEMICAL STUDIES OF SALMON.

Without expense to the Bureau, Prof. C. W. Greene, of the University of Missouri, has continued his chemical studies of material collected several years ago to determine the changes in salmon ovaries and tissues during the period of migration from sea to breeding grounds. The results of such studies can at first be given only technical expression, but they are none the less likely to yield in the end data of direct economic value.

The chemistry of the king salmon ovaries during their development in the migration period followed in the year 1908 on a series of samples collected on the Columbia River and its tributaries has been tabulated and prepared for publication.

These studies show the following major points: First, the growth of the ovary takes place primarily during the migration while the salmon is fasting. The average increase in weight is from about 135 to 150 grams at the end of the feeding period to 2,000 to 2,500 grams at maturity. In short, about 90 per cent or more of the development takes place during the prolonged fast of the migration.

Chemical analyses of developing ovaries show that between the 500-gram stage and the mature-egg stage there is a remarkable uniformity of chemical composition. The proteins are high, averaging from 29.38 to 31.16 per cent. This is undoubtedly all stored protein. The neutral fats decrease with the development and migration, from an average of 14.15 per cent at the mouth of the river to 10.83 per cent at the spawning. Phospholipins average 4.78 at the mouth of

the river and 2.85 at the spawning, showing a decrease with development. The phospholipins are much lower than in the yolk of bird eggs, the hen's egg averaging 11 per cent. The water-soluble organic extractives and the ash are both remarkably uniform, the extractives averaging 1.87 to 1.65, the ash 0.66 to 0.81 per cent. The organic extractives and ash are both low in comparison with other salmon tissues, but compare favorably with their percentages in the yolk of other eggs.

The salient points in this study are found in the showing of high protein storage in the salmon-egg yolk, the relatively low percentage of neutral fats and of phospholipins, and the decrease of neutral fats and phospholipins during development. Since in other eggs these fatty constituents are higher and tend to increase with development, it is probable that in the salmon the decrease is due to the extreme drain on the fatty deposits for the production of dynamic energy during the migration.

Determination of carbohydrate content of certain tissues of the king salmon during the spawning migration was undertaken as an accessory test. The gross samples were preserved in alcohol, and in the final analysis all glycogen was converted to glucose and the determination made in that form. The results show a very low glucose content of all organs and tissues. Glucose was present in all the tissues of the feeding salmon. Monterey Bay and Bolinas Bay specimens, but was absent or in reduced amount in the migrating and spawning salmon, with the exception of one tissue, the ovaries. In the ovaries, the percentage of glucose was practically constant throughout the migration.

LIFE HISTORIES OF MARINE FISHES.

During July and August, 1920, studies of the life histories of fishes of the middle Atlantic coast were carried on by W. W. Welsh, scientific assistant, aided by C. M. Breder, at a temporary station on Young's Pier, Atlantic City, N. J. Through the courtesy of Capt. J. L. Young, owner of the pier, a serviceable two-room building, formerly used as a wireless telegraph office, was adapted for use as a laboratory. A small hatchery, equipped with tidal box and Chester jars, was set up and supplied with filtered salt water from the pier aquarium. A great variety of material was obtained from the two pound nets operated under the pier. Eggs of several species, obtained from fish taken in these nets, were hatched in Chester jars, and the fry carried on as long as possible for study. Series of scale samples for the determination of age and growth were also taken.

Among the species studied were northern and southern king whiting (*Menticirrhus saxatilis* and *M. americanus*), squeteague (*Cynoscion regalis*), spot (*Leiostomus xanthurus*), croaker (*Micropogon undulatus*), silver perch (*Bairdiella chrysura*), menhaden (*Brevoortia tyrannus*), and puffer (*Spheroideus maculatus*).

Although the facilities generously furnished by Capt. Young could hardly have been improved upon, the work was greatly handicapped by the abnormally cold water which prevailed throughout the summer. Water temperatures ranged from 53 to 65° F. and averaged about 57° F. This low temperature is believed to be the cause of the

scarcity or entire absence of a number of species which it was hoped could be obtained and studied.

The same investigators completed during the year a valuable report on the life histories of fishes of the family *Sciaenidae* of the Atlantic and Gulf coasts. The family includes some of the most important food fishes, the annual catch on these coasts approximating \$3,000,000 in value. No less than 37½ per cent of the fish landed at the municipal fish wharf, Washington, D. C., in 1919 were of this family; the principal species were the squeteague, or weakfish, often erroneously called sea trout, the highly esteemed king whiting, the red drum, or channel bass, the croaker, spot, and silver perch.

How can we act intelligently with reference to the exploitation of such resources or determine wisely how to preserve them for all time if we do not know the life histories of the fishes, when and where they breed, their migrations in summer and in winter, the rate of growth, and the food they require? The present report not only brings together the fragmentary data hitherto available but adds materially to existing knowledge by embodying the results of years of researches, particularly those of the senior author, whose death unfortunately preceded the final completion of the paper.

The report also serves the valuable purpose of making evident the gaps in existing knowledge, revealing the need of additional observations, and showing plainly the directions which further studies should follow. As similar work is done for other families of fishes we shall come nearer to realizing the practical value of applying science to the study of fishes.

Mr. Welsh also completed descriptions of seven new species of marine fishes (*Malacopterygii*) taken during the explorations of the United States Coast and Geodetic Survey steamer *Bache*, conducted in 1914 under the direction of the United States Bureau of Fisheries. The fish were taken at various stations in the vicinities, respectively, of Cape Hatteras, the Bermudas, and Bahama Islands. After Mr. Welsh's death the descriptions were prepared for publication by C. M. Breder. The report has been accepted for publication by the United States National Museum.

Both assistants have been lost to the Bureau during the year, the one by untimely death, the other by resignation.

FRESH-WATER FISHES.

WHITEFISHES OF THE GREAT LAKES.

There is scarcely a sadder feature of the history of American fisheries than the progressive depletion of the important resources of the Great Lakes, notably in respect to the whitefishes. We may have overestimated the possibilities of exploitation, we may have been shortsighted in the fishery policies we pursued, or we may not have propagated them with proper energy or efficiency. But the simple fact is that no one has had enough knowledge of the distribution, habits, and requirements of whitefishes to give proper advice. The best intentions can not save a situation when founded upon ignorance. If the whitefish fisheries of the Great Lakes are to be preserved to the future or perhaps restored in part to their earlier rank, we must study the fishes and ascertain the condition of their existence.

Therefore, for several years the Bureau has had a skilled assistant devote exclusive attention to the whitefishes and related species. This investigation, pursued by Walter Koelz, scientific assistant, is not all that is required, but it will surely provide a fund of information for more intelligent guidance in future.

The investigation of the systematic relationships and habits of the coregonines was conducted in the year 1920 on Lake Michigan. Forms allied to those which the investigations of the previous year disclosed in Lake Huron, and in addition two undescribed species, of which at least one is now known to occur also in Huron, were obtained. Diagnoses of the species have been prepared from over 2,000 preserved specimens. Data have been collected bearing on the distribution in the lake and on the spawning habits of the various forms. To avoid dissemination of premature conclusions a report will not be published until work is done upon other lakes.

These studies have been supplemented by microscopic examination of the scales and systematic investigation of the food, conducted, respectively, by John Van Oosten and Carl L. Hubbs, temporary investigators, under the direction of Prof. Jacob Reighard.

Mr. Van Oosten first determined that the scale characters of the lake herring (*Coregonus artedii*) are so well defined as to permit the determination from them of the age of individuals and the rate of growth of the species. The variations in the scales of individuals were found to be within specific limits. But scales from different parts of the body of an individual are so unlike that for comparison of individuals or species it is necessary to use scales from the same body region.

The scales of 10 specimens of each of the 10 Lake Huron forms recognized by Koelz were next compared, and it was found that 8 of them (including the two races) are discriminable. Further study will probably enable discrimination of the two other forms. It appeared that in one of these forms (*Coregonus artedii*) there are probably two geographic races which differ in rate of growth, but the matter needs further study.

Through the courtesy of Dr. C. H. Townsend, director of the New York Aquarium, it was possible to secure specimens of whitefish (*Coregonus clupeaformis*) hatched and reared at the aquarium and therefore of known age (7 years). The 10 specimens studied show that there is one annulus for each year of age. This, so far as known, is the first demonstration of this fact and enables the determination of the age of coregonine fish from scale characters to be undertaken with confidence. Two individuals of the 7-year-old whitefish were segregated at the New York Aquarium and kept living, while scales were removed at intervals of a month. A study of these scales shows that the annuli are formed in winter, fixes the time of formation, and indicates temperature change as one of the factors. It is believed that a continuation of these studies will add materially to our knowledge of age and rate of growth of coregonine fishes, aid in their systematic grouping, and lead to the discovery of local races in some of the forms.

The food of the whitefish, lake herring, and allied species of Lake Huron coregonines in the Koelz collection was investigated by a volumetric method by Carl L. Hubbs, of the Museum of Zoology,

University of Michigan. The deep-water forms, as the blackfin (*Leucichthys nigripinnis*), were found to feed almost exclusively upon the crustacean *Mysis relicta*, probably the only available food. The deep-water race of the bloater (*Leucichthys hoyi*) feeds chiefly on *Mysis*, while a 30-fathom race eats for the most part another lake crustacean, *Pontoporeia hoyi*. The food of the shallow-water forms is much more varied. The pilot or menominee (*Prosopium quadrilaterale*) is strictly a bottom feeder, subsisting on mollusks, insect larvæ, crayfishes, etc. The whitefish (*Coregonus clupeaformis*) is also a bottom feeder, but its food is, on the average, not so coarse as that of the pilot, consisting largely of insect larvæ, as those of the mayflies *Hexagenia* and *Ephemera*. The lake herring feeds in part upon the same animals, in part upon the minute Crustacea of the plankton. In reference to their available food supply the deep-water forms are absolutely competitive (more so perhaps than any other group of fishes), while the shallow-water forms are only in part competitive. It is probable, however, in view of the former greater abundance of these fishes, that sufficient food exists in the lakes to support a larger population of all the species of whitefishes.

FISHES OF WISCONSIN LAKES.

The food and distribution of the fishes in certain Wisconsin lakes have been studied by Dr. A. S. Pearse.⁴ The results indicate that in summer fishes are generally more abundant as conditions approach those in swamps and are fewest when the environment is most like that in rivers. When food is present in quantity and when other conditions are favorable, there are more fishes per unit area in certain inland lakes than in the Mississippi River or in Lake Michigan. Lakes produce considerable food supplies within themselves, while rivers are more dependent on swamps, ponds, and other tributaries. The factors of importance in limiting the distribution of fishes are discussed (shores, turbidity, depth, bottom, height of water, currents, etc.). An abundant supply of food and vegetation permits many fishes to *exist* in a lake, but other favorable conditions must be present in order that they may grow to large size.

A statistical study of the infection of fishes by parasites has been made, the Mississippi and St. Lawrence drainage systems being compared, and various types of lakes studied. The results are now being tabulated and will soon be ready for publication. A short paper on the habits of the mud puppy, in which its relations to fishes are discussed, has been published.⁵

In order to secure information on the rate of growth of cold-blooded animals in natural conditions, attempts are being made to recover the fishes and turtles tagged and released in Lake Mendota during the summer of 1919. Some specimens have already been secured.

Studies on the metabolism of fishes are being continued. In this connection quantitative analyses are being made to show the water, ash, nitrogen, and ether extractives of fishes at various stages of growth.

⁴ Pearse, A. S.: The Distribution and Food of the Fishes of Three Wisconsin Lakes in Summer. University of Wisconsin Studies in Science, No. 3, June, 1921, 60 p. Madison.

⁵ Pearse, A. S.: Habits of the Mud-Puppy *Necturus*, an Enemy of Food Fishes. Bureau of Fisheries, Economic Circular No. 49, issued May 16, 1921, 8 p. Washington.

THE PADDLEFISH.

The study of the natural history and artificial propagation of the paddlefish in Bayou Pierre at Westdale, La., was continued by Dr. A. D. Howard, scientific assistant, with the cooperation of the Louisiana Conservation Commission. During March good catches of egg-bearing females and sufficiently ripe males were obtained, but no females were ripe enough to allow of fertilization of eggs. Late in the month heavy rains flooded the Red River and Bayou Pierre and prevented the capture of fish in sufficient numbers to continue the investigation.

There are few added data regarding the breeding grounds of the fish and the time and manner of spawning. Some information of minor importance was obtained regarding certain habits of the species. Bottoms suspected of being the breeding grounds of the paddlefish were dredged for the purpose of obtaining eggs, but without success.

POISONOUS ACTION OF GAR ROE.

In a previous year experimental attempts to produce caviar of gar roe were made by Prof. C. W. Greene, temporary investigator. Out of this work it developed that the pigment in the gar roe is not a melanin as in the sturgeon roe, but a form of pigment that changes color under various chemical treatments of the roe. The pigment color is changed to an orange red on boiling the gar eggs, on treatment with alcohol or ether, and on salting. This changes the commercial quality of the product and gives easy methods for detecting the adulteration of sturgeon roe by gar roe.

The important observation, however, was the demonstration of an active physiological principle of a toxic nature present in gar roe. It is apparently this principle that gives the unpleasant acrid taste to gar-roe caviar. When tested biologically by the method of feeding the natural product the following points were made: (1) Gar roe is poisonous to the chicken and to the rat; (2) it paralyzes the neuromuscular mechanism of the chicken crop; (3) it produces in the rat an intestinal irritation with active diarrhea.

During the summer of 1920 a series of experiments were made to chemically separate and biologically test the unknown toxic substance. It was shown that (1) extracts in boiling water free from coagulable protein and (2) similar alcoholic extracts contained an active principle toxic to the heart of the frog; (3) globulin fractions made by the method of salting out, centrifuging, and purifying by dialysis were sharply toxic to the heart; (4) the globulin fractions fed to a young rat produced extreme diarrhea and death in about 20 hours, effects comparable to feeding the entire fresh ovary; (5) the effect on the chicken's crop was positively toxic; (6) not only was the crop paralyzed but an acute diarrhea occurred in the chicken through some alimentary canal poisoning; (7) these effects also occurred after feeding the purified globulin.

Attempts to isolate and identify the individual chemicals, of which at least two classes are present, have thus far not been brought to a successful issue. Further experiments are planned.

FISHES OF THE PANAMA REGION.

The Bureau of Fisheries, late in 1910, entered into an agreement with the Smithsonian Institution and the Field Museum of Natural History for a cooperative study of the fishes of the Panama Canal Zone. The work was carried on under the auspices of the Smithsonian Biological Survey of the Panama Canal Zone. The field work was done by Dr. Seth E. Meek, of the Field Museum, and Samuel F. Hildebrand, of the Bureau of Fisheries, during two expeditions made to the Canal Zone, from January to June, 1911, and January to March, 1912, respectively. The study of the collections which were sent to the National Museum was begun during the interval between the two expeditions and continued after the second visit to Panama by the collectors. After two small preliminary papers containing descriptions of new species of fresh-water fishes had been written, and a majority of the forms had been roughly identified and separated, Dr. Meek was obliged to withdraw from the work because of an illness from which he never recovered. The completion of the work was then left to Mr. Hildebrand. As other duties were necessarily assigned to Mr. Hildebrand from time to time, the completion of the study of the collections was greatly delayed. The final report on the fresh-water fishes, however, was completed and published in 1916, but the study of the marine forms was not completed until the spring of 1921. In the last months of the work the author was assisted by W. C. Schroeder.

The total number of species recorded from the coasts of Panama, either taken by Messrs. Meek and Hildebrand, or previous collectors, or both, is 640. The remainder of the species included in the paper were discussed because their known range of distribution is such that they may be expected on the coasts of the Isthmus. The fishes on the Pacific coast run larger than those on the Atlantic and are more numerous both as to species and individuals. Much more collecting, however, has been done on the Pacific side than on the Atlantic, which undoubtedly accounts in part for the large difference in the number of species recorded. The total number of species listed as common to both coasts of Panama is 72, but of these 48 are more or less cosmopolitan in their distribution, that is, they are not confined to American waters. A very large number of species considered distinct are, however, very closely related, differing only slightly but in apparently constant characters.

It was pointed out in the report on the fresh-water species that the fishes of the opposite slopes of Panama are very closely related, some of them remaining identical. This close relationship indicates that the fishes of the two slopes had not long been separated. Since the opening of the Canal they, of course, can again freely intermingle in those streams which are connected with the Canal. The close parallelism of the marine species of the opposite coasts is evidence of a comparatively recent passageway from ocean to ocean, even for salt-water forms. The genera of many families have representatives on both coasts, and if they do not include identical species they at least have very closely related forms on the opposite coasts. A few families, however, deviate from this general rule in having many more representatives on one coast than on the other. The reasons

for this may be found by consideration of the habits of the species of those families which do not conform to the usual rule. The Siluridae (including the catfishes), for example, are very much more numerous on the Pacific coast than on the Atlantic. The Scaridae (including the parrot fishes and viejas), on the other hand, are much more numerous on the Atlantic than on the Pacific. It is well known that most catfishes frequent water with soft or muddy bottom. The Pacific coast of Panama has many large mud flats partly or wholly exposed at low tide but flooded during high water. The Scaridae prefer rocky bottom, and especially coral reefs, which are large and extensive on the Atlantic side. These conditions undoubtedly prevailed, in part at least, before the last passageway between the two oceans was closed, and it is probable that these families had already sought out regions best suited to their particular needs.

The commercial fisheries of Panama are still largely undeveloped. The possibilities for profitable fisheries appear to be especially good on the Pacific coast, but apparently less promising on the Atlantic side of the Isthmus. The people of the Isthmus are less wasteful of fishes than the people of the United States, as nearly all species of fish taken, including sharks and skates, are utilized as food.

PACIFIC HERRING.

During the year the Bureau issued a memorandum dealing with the distribution, migrations, sizes, and spawning times and places of the Pacific herring in southeast Alaska and British Columbia, based upon the observations of D. R. Crawford, scientific assistant.

There are apparently two races of herring (*Clupea pallasii*), one of which resides in the bays and inner waterways along the coast from Puget Sound northward to British Columbia and southeast Alaska. The other, which is composed of larger individuals, passes along the outer coasts where it is taken off Vancouver Island in June, July, and August.

The smaller race of herring is found to be sexually mature in the summer, but no milt or roe is found during the winter. Sexually mature individuals vary in size from 6 to 10 inches. The probable spawning time is late summer or early fall. The larger race of herring reaches sexual maturity in the fall and winter, the individuals varying in size from 9 to 12 inches or longer. The probable spawning time is winter or early spring.

USE OF FISH IN COMBATING MALARIA.

COOPERATION IN ANTIMALARIA CAMPAIGN.

Investigations of fishes in relation to mosquito control were conducted during the mosquito-breeding season of 1920 by Samuel F. Hildebrand, scientific assistant, working in cooperation with the United States Public Health Service. In the spring and early part of the summer Mr. Hildebrand inspected various localities in 12 Southern States where malaria-control work was to be undertaken. Suggestions were offered concerning the employment of fish for the control of the mosquito, and the waters suitable for fish control were pointed out to the officers in charge. The result of these inspections

was that the top minnow, *Gambusia affinis*, was very widely employed as an agent in the control of malaria. A report of observations made by Mr. Hildebrand during this campaign has been published by the Public Health Service.⁶

The latter part of the season was devoted to investigations at Savannah, Ga., where a special effort was made to determine the relative value as eradicators of mosquito larvæ of two other American viviparous species of fishes, *Heterandria formosa* and *Mollienisia latipinna*, both of which are abundant at Savannah. It was demonstrated that *Heterandria formosa* is of real value and is well worth careful consideration wherever it occurs. *Mollienisia latipinna*, on the other hand, appeared to be practically worthless.

The antimalaria campaigns in the various States were brought to a close early in November, in which month the annual meeting of the National Malaria Committee and the conference of sanitary engineers engaged in antimalaria work took place in Louisville, Ky., where the outcome of the past season's campaign was reported and discussed. The subject of mosquito control by the use of top minnows received extended discussion, and the fact was brought out that nearly every sanitary engineer had made use of *Gambusia affinis* as an agent in malaria control with excellent results. The saving of large sums of money was reported, because fish control replaced other methods at much less expense.

Similar advisory work was done by Mr. Hildebrand in the spring of 1921 before establishing headquarters at Augusta, Ga., for further investigations to determine more fully the conditions of effectiveness in the employment of fish for destruction of disease-bearing mosquitoes.

CONDITIONS GOVERNING ABUNDANCE OF MOSQUITO-DESTROYING FISH.

R. L. Barney and Barry Anson have continued the organization and summarizing of data collected at Mound, La., where investigations of the use of fish for control of mosquito breeding were previously conducted in cooperation with the Bureau of Entomology.

Reports⁷ printed outside the Bureau's publications demonstrate the varying seasonal frequency of *Gambusia*, the mosquito-eating fish; the seasonal variation in the proportions of the sexes and its bearing on the abundance of the species in nature; the effect of environment on the abundance of the species; and the relation of plants of varying habits of growth to oxygen supply and to the capacity of small ponds to support the top-minnow *Gambusia*. Further observations have been made on the seasonal abundance of *Gambusia*, especially in relation to the fecundity of the species. Appropriate consideration has been given certain points concerning the anatomy of the female reproductive organs of this fish.

⁶ Hildebrand, Samuel F.: Top Minnows in Relation to Malaria Control, With Notes on Their Habits and Distribution. Treasury Department, Public Health Bulletin No. 114, May, 1921, 34 p. Washington.

⁷ Barney, R. L., and Anson, B. J.: Relation of Certain Aquatic Plants to Oxygen Supply and to Capacity of Small Ponds to Support the Top-minnow (*Gambusia affinis*). Transactions, American Fisheries Society, 1920, pp. 268-278.

Abundance of the Mosquito Destroying Top-minnow *Gambusia affinis*, Especially in Relation to Male Frequency. Ecology, Vol. 11, No. 1, January, 1921, pp. 53-69.

The study of the natural history and ecology of the pigmy sunfish, *Elassoma zonatum*, has been concluded and given publication.⁶ It appears that this fish, under certain conditions, may have some value in eradicating immature mosquitoes.

MOSQUITO CONTROL IN NORTHERN WATERS.

While in northern States mosquitoes have a less acute relation to public health than in regions where malaria is prevalent, they nevertheless constitute there a distinct menace to health and efficiency, besides being effective in causing a material reduction of property values, especially in regions which are normally resorted to for purposes of recreation and recuperation of vigor. During the year Prof. J. P. Moore, temporary investigator, has completed a report upon his observations of the use of fish and other aquatic animals for the control of mosquito breeding in northeastern States. His conclusions and suggestions may be summarized.

Although no fish to which mosquitoes are more than an incidental item of the diet has been found in the fresh waters of the northeastern States, nevertheless several species of small fishes and the young of some large ones native to these waters eat mosquito larvæ, pupæ, and eggs more or less habitually. The most important of these mosquito repressors are the common sunfish, the mud minnow, and the common killifish.

Fishes are found to be far more detrimental to culicine than to anophelene mosquitoes. While in the aggregate they destroy vast numbers of eggs, larvæ, and pupæ, and (along with other enemies) probably prevent mosquitoes from becoming everywhere an intolerable nuisance, the destruction is never complete. Some breeding of mosquitoes continues in nearly all bodies of fresh water even when well stocked with mosquito-eating fishes. This imperfect suppression arises through conditions limiting the efficacy of the fishes, most important of which are (1) the barriers that almost all natural bodies of water afford and which prevent the fishes from finding the young mosquitoes, and (2) the abundance of other food for the fishes. Most native mosquito-eating fishes will not thrive in water contaminated by excess of decaying vegetation or otherwise.

The most prevalent of the barriers is the shallow water and marginal vegetation. In ponds formed by dams provided with head gates a simple, effective, and economical method of controlling and reducing marginal vegetation is by lowering and raising the water level periodically, thus alternately drying and drowning the plants. In ponds and lakes of fixed level mechanical means of clearing the margins must be employed.

The most practical method of keeping the per capita food supply low is by overstocking with a variety of small fishes. Reduction of the vegetation also diminishes the supply of fish food.

The common sunfish (*Eupomotis gibbosus*) is the most useful species for ponds and lakes generally. With it may be associated the long-eared sunfish (*Lepomis auritus*), roach (*Abramis chrysolaucus*), some of the smaller minnows, black bass, etc. If there is much

⁶ Barney, R. L., and Anson, B. J.: Life History and Ecology of the Pigmy Sunfish (*Elassoma zonatum*). Ecology, Vol. 1, No. 4, October, 1920, pp. 241-256.

aquatic vegetation the blue-spotted sunfish will prove a valuable addition, and if very shallow or swampy areas occur, the mud minnow. The common killifish is very effective in fresh and brackish tidal marshes, and the translucent killifish is useful in upland creeks and dams. Rapid multiplication of small fishes should be encouraged by providing suitable nesting sites and protection for the fry.

Gambusia, the favored top minnow of southern waters, has not survived the northern winters but multiplies so rapidly that it may be used effectively against both *Culex* and *Anopheles* in small ponds and water gardens by planting a small number each spring. Small goldfishes are useful in fountain basins and small ponds with clean sides, and, for use in rain barrels and tanks, are preferable to *Gambusia*.

FISH-CULTURAL EXPERIMENT WORK.

EXPERIMENTS IN PROPAGATING AND REARING FISH IN PONDS.

The Fairport station has continued its valuable experimental work in reference to the propagation and rearing of fishes in ponds. Certain observations were made on the value of fertilizing ponds with chemicals and manure, but data obtained to date are inconclusive. Further study will be directed toward this problem.

The small pond, which for several years has been handled as a farm pond with minimum care and expense, has yielded valuable information. Originally it was stocked with bluegill sunfish. Occasionally, when necessary, the pond has been wintered out. There has been no manipulation of the pond in any respect other than the control of the number of bluegills of various ages in it. During the past year the actual production of fish meat in the ponds has been 333 pounds per acre. Of this, however, fishes of edible size represented about 33 per cent of the total fish-meat production. In this connection it may be well to note that the average annual production of beef per acre on untilled meadowland is said to be 125 pounds; that for hogs is 225 pounds.

Buffalofish, *Ictiobus cyprinella*, artificially reared in the station ponds, reached maturity and produced young for the first time at the age of 4 years. They averaged 13.6 inches in length and approximately 2 pounds in weight. The small-mouth buffalofish, *Ictiobus bubalus*, which in previous years had failed to spawn in the experimental ponds unless an artificial rise in the level of the pond was produced, spawned this year in a pond in which the rise did not occur. While the production of fry of this species does not appear to be as numerous as for those fish held in the pond with artificial rise, the occurrence indicates that the rise is not entirely necessary, though it may be advantageous.

The channel catfish, *Ictalurus punctatus*, for which this station showed the feasibility of pond culture, has continued to spawn in the experimental ponds. Certain 4-year-old offspring of wild stock came to sexual maturity during the year and produced the first brood of truly domestic fish. The adaptability of this species to pond culture is suggested by the fact that the catfish has spawned in certain of the smallest ponds on the reservation, one of which has a water-surface area, when completely full, of only 3,485 square feet (less than one-twelfth of an acre).

WATER BEETLES IN RELATION TO POND CULTURE.

The home fishpond is a subject of continued interest among farmers and others who value the additional table food made available or the means of recreation provided. There must be a great deal in a pond besides fish; otherwise the fish would starve. There must be small animals which serve as food to fish and still smaller animals and plants which serve as food for them. Some things in a pond are desirable, others objectionable in varying degree. The fishpond is, indeed, not a simple thing, but a very elaborate complex, the scientific unraveling of which is necessary before the best plans of pond management can be known. The unraveling of the complex can be accomplished eventually only by tracing particular threads, that is, by centering attention at one time upon a particular group or species of the inhabitants of the water. An instance of such special studies carried through to a point where helpful practical conclusions are derived is afforded by the investigation of water beetles conducted at the Fairport station.

Dr. C. B. Wilson has made a comprehensive study of the rôle beetles play in pondfish culture. He has found that larvæ and adults of the three beetle genera, *Hydrophilus*, *Dytiscus*, and *Cybister*, destroy small fish under normal conditions. The larvæ of *Dinectes* are known to have killed and eaten fish fry under certain abnormal conditions. The larvæ of three other genera (*Acilius*, *Graphoderes*, and *Hydrocharis*) are suspected of being capable of committing similar depredation.

On the other hand, both beetle larvæ and adults are eaten freely by the young of nearly all our common food and game fishes after the latter attain a length of 25 to 40 millimeters. This is just as true of the seven genera mentioned above as of the others that are harmless.

Practically speaking, only the young fish of the year are menaced by beetles. Fish a year or more old are large enough to feed on the beetles and are almost never attacked by the latter. Consequently beetles are really harmful only in breeding ponds, and even in those places, as everywhere else, they contribute materially to the available food supply for the fish.

Adult beetles migrate and travel so constantly that every fishpond is sure to be stocked with them as soon as it is completed, and yet the beetles of two ponds side by side are likely to differ radically in numbers and variety. If they occasion trouble in one pond, the temporary removal of the fish to another pond will usually prove an effectual remedy. Beetles may also be kept in check by abruptly raising and lowering the water in the pond at intervals of a week or 10 days during their breeding season in July and August.

STUDIES OF SALMONIDÆ IN RELATION TO FISH CULTURE.

In a previous report reference in detail was made to the investigations by Dr. W. C. Kendall of rainbow and steelhead trout and of some hitherto unrecognized anatomical characters of trout which seemed to have a direct bearing upon fish-cultural practices. It is worthy of note that the results of the latter investigation were deemed of such value by independent persons that the report upon them was

awarded a prize by the American Fisheries Society as the most important contribution in the application of biological science to the advancement of fish culture. A series of practical experiments based upon these results was conducted during the winter at one of the fish-cultural stations of the Bureau. Just before the close of the year they were transferred to another station where more adequate facilities were available, and it is planned to continue them during the coming fiscal year that definite results may be obtained.

MINNOWS IN RELATION TO FISH CULTURE.

The smaller members of the minnow family are important to fish culture since they represent a primary source of food for more than 20 of the larger food and game fishes. The success of the introduction of game fish into streams or ponds necessarily depends to no small extent upon the suitability of the stream or pond for the support of minnows. Hence the budget of knowledge requisite for efficient fish culture includes information regarding the food and other requirements of minnows. Therefore, while the study of minnows by C. M. Breder and D. R. Crawford, scientific assistants, was conducted almost entirely outside of office hours and represents a by-product as it were, the results gained are of practical value.

They studied six common species in the vicinity of the District of Columbia: chub minnow, *Semotilus bullaris*; red-bellied dace, *Leuciscus vandersalis*; *Notropis proce*; shiner or red fin, *Notropis cornutus*; black-nosed dace, *Rhinichthys atronasus*; cutlip, *Exoglossum maxillingua*. All were found to be predominantly carnivorous, insects forming the bulk of the food taken, although two species, *Notropis proce* and *Exoglossum maxillingua*, consumed much vegetable matter. Various worms, filamentous algae, and diatoms entered into the food in considerable quantities. These minnows are, therefore, in direct competition with the young of important game fish and may even prey upon the fry of them. It is suggested, therefore, that if minnows are introduced into ponds as food for game fish, discretion should be exercised regarding the use of larger and more rapidly growing minnows, such as the chub minnow and red fin, which may outstrip young trout in growth and under some circumstances become a menace rather than a benefit.

In all cases the suitability of the introduction depends both upon the species of minnow and upon the species of fish which is to be fostered, as well as upon other conditions prevailing in the water and upon the degree to which the various factors are under the control of the fish culturist. Minnows seem to thrive best in streams or ponds where the banks bear overhanging vegetation that supports an abundance of insect-life. Where this condition prevails there is probably less likelihood that the minnows will prey upon the eggs or young of other fishes.

A NEW FORM OF POND OUTLET.

Practical success in fish culture depends in no little measure upon economy in construction and operation of the pond and upon the convenience with which it can be drained for removal of brood stock or young, elimination of enemies, cleaning the bottom, or removing obnoxious plants. The concrete-box outlets commonly used are not

only expensive, but they are also frequently a subsequent source of annoyance, expense, and loss of fish, when damaged as the result of freezing and thawing. It is worthy of special comment, therefore, that H. L. Canfield, superintendent of fish culture at the Fisheries biological station, Fairport, Iowa, has devised a type of pond outlet which has been found, after long trial, to be both relatively inexpensive of installation and convenient and enduring in operation. The Canfield L outlet, here described and illustrated, provides both for all ordinary overflow and for draining the pond as easily and quickly as with the concrete outlet.

The outlet consists of two pieces of threaded pipe of required length screwed hand-tight into an elbow. When connected for service one pipe is joined to the drainage line, and the other, the elbow acting as a hinge, becomes a movable standpipe, the raising and lowering of which controls the depth of the water in the pond. A pipe stop about 2 feet high is arranged back of the elbow to stay the standpipe from passing the center.

Two or three cement blocks about 2 by 2 by 2 feet are set about the drainage line to anchor it and to give protection to the embankment against animals and water seepage leading into it along the line. These blocks serve also as couplings for the joining of the pipe to the drainage line and for other connections in the line as desired. When a kettle is used one block joins a side of it, anchoring the pipe connection with the drainage line and serving as a base for a walk support. A second block is placed about the drainage line approximately beneath the top and inside edge of the embankment. This is usually a drainage line connection block. If the drainage line passes entirely through the embankment a third block should be placed around it several feet into the embankment from the outside.

The outlet screen consists of a half coupling (whole coupling if desired) with a quarter-inch groove around it 2 inches below its top, to which is attached, by means of galvanized wire, a covered cylindrical screen of desired mesh, 1 foot high. This is screwed to the outlet pipe. A cylindrical or square screen of large proportion may be installed about the standpipe if maximum screen area is needed, although for general use this will not be required.

A cement kettle 12 by 6 by 1 foot set parallel to the embankment, and within this kettle a small kettle about 15 inches wide, 3 inches deep, and about 7 feet long (long enough and wide enough to admit the standpipe with screen, when down level) are used at Fairport with the L outlet. The drainpipe enters the side of the main kettle about 6 inches from the elbow and 1 foot from the end. The bottom of the inner kettle is made level with the base of the outlet pipe when it is down level in position to drain, and provision is made for the removal of the elbow by cupping out the cement beneath it and filling the space with clay, to prevent the trapping of fish when the pond is drained. The main kettle has a slight rise from the inner kettle to the sides to provide drainage.

A walk of 2-inch plank supported by 2 by 4 inch stringers is made to extend from the embankment to within a foot of the outlet screen, the stringers resting about 6 inches above the top of the outlet pipe when erect. This walk rests on two pipe supports which extend from the cement blocks in the drainage line.

The standpipe is chained to the sides of the outer walk support by a piece of galvanized pump chain the length of the distance the pipe travels. This chain passes through a loop eye in the post and is provided with a ring larger than the eye, so that the end of the chain can not be drawn through. By means of this chain the standpipe may be raised and lowered and the level of the water in the ponds adjusted and held as desired. An ordinary lock, or an iron bolt may be used to secure the chain in the loop.

Malleable iron pipe is excellent material for the outlet, but ordinary black steel pipe is cheaper and gives good service. One piece of pipe of required length for the standpipe, threaded both ends, an elbow, and about 2 to 2½ feet of pipe threaded one end, to serve as connecting pipe with the drainage line, are all the materials required for the outlet. It is recommended, however, that metal pipe be provided from the elbow well into the embankment for the better protection of the drainage line. Eight-inch pipe is recommended for ponds of 1 acre in area and proportionately smaller pipe for smaller ponds.

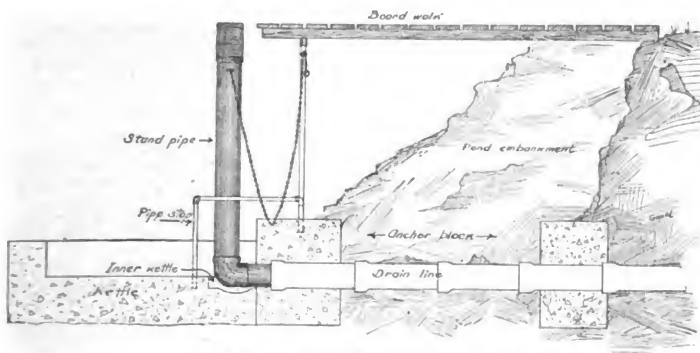


FIG. 1.—The Canfield pond outlet, side view.

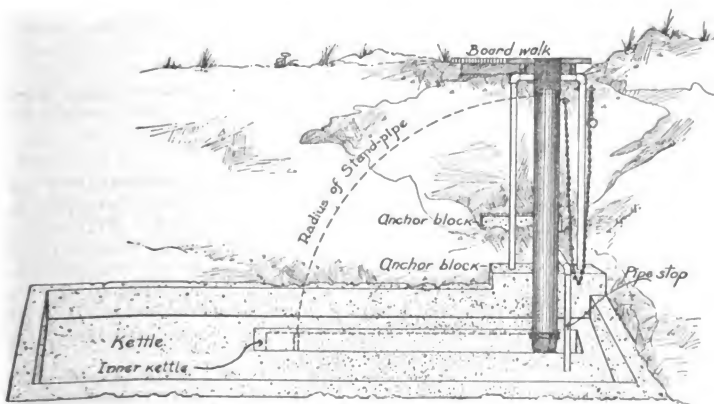


FIG. 2.—The Canfield pond outlet, end view.

It is well to paint the pipes with waterproof paint, and a mixture of graphite and oil is recommended for use in the elbow and coupling threads. Pipe threads should penetrate elbow 1 inch, hand screwed. When the drainage line is to be of terra cotta its joints should be sealed with cement throughout the line rather than laid partly open, as is sometimes done.

The elbow and two pieces of threaded pipe comprising the outlet proper and modifications as to size and detail of the L outlet and appurtenances may be made to suit requirements and material available. If it is necessary to reduce expense, the kettles may be reduced or omitted entirely, but the installation of a kettle, even though of small size, is recommended because of its usefulness when drawing the pond and sorting the fish. The cement blocks, the chief use of which is to protect the outlet drainage line against water working an opening about it, and which also prevents animals such as crayfish and muskrats following it through the embankment, must not be omitted because without the blocks to protect and stay the drainage line leakage is certain to occur. The depth of these blocks should not be reduced, but in unfavorable soil may be increased to advantage.

All surfaces over which embankments are to be laid should be plowed before the fill is commenced, so that the earth will bind satisfactorily, and all foreign matter such as brush, rock, etc., should be excluded from the fill dirt.

The outlet is placed at the drain point and stayed as described, after which the fill is laid over it, the outlet being ready for service as soon as the fill is started. Pipe 4 to 6 inches in diameter is sufficiently large for ponds of less than 1 acre in area. It is always better to have the outlet pipe too large rather than too small.

Many of the spillways and outlets in general use give more or less trouble through leakage, and those of cement construction often freeze and crack, or settle and crack, causing serious trouble and considerable expense. Many of the outlets in use are built into the embankment, thereby weakening and subjecting the embankment to the danger of washouts. Loss of fishes often arises from screens below the water surface becoming damaged, and many outlets, when the pond is being drawn, have too much suction for the good of the little fish. These and other troubles have been eliminated in the L outlet, some favorable features of which are enumerated below:

The action of the outlet is quick and easy.

Leakage and freezing difficulties have been overcome.

The outlet operating from the surface provides minimum suction, which works to the benefit of small fish.

The screen is visible, therefore safe, and easily cleaned.

The outlet does not weaken the pond embankment.

The outlet may be assembled, installed, and maintained at low cost, and is so simple of construction that any "handy man" can build and install it.

ERADICATION OF SOME OBJECTIONABLE PLANTS.

The rank growth of cat-tails in ponds and lakes, particularly at fish-cultural stations, has often become a serious nuisance, causing a substantial reduction in the effective area of the pond. Hitherto there has been no inexpensive or practicable method of combating them, since removal by cutting alone is quite ineffectual. Superintendent Canfield has devised and demonstrated the efficacy of a method of elimination of these plants, based upon the necessity of aeration through contact of the plant or its landward roots with the air.

The water level in the pond is lowered below the limit of growth of the cat-tails, which should then be mowed as low as practicable. With spade or plow a ditch is made below the normal water line and between the cat-tails and the shore. The ditch must be sufficiently deep to sever the roots that connect the plants in the pond with the shore or with any plants that are allowed to remain above the ditch. In this way the air supply from the land roots is completely cut off. The pond should then be immediately flooded and the water

level continuously maintained above the stubble for a week or 10 days, when the cat-tails will have been killed out. It is essential to flood the stubble immediately after mowing in order to get ahead of the rapid growth of the cat-tails. If in consequence of stored oxygen in the severed roots a few weakling shoots should appear above the water surface, they should be pulled out; when this is done a few times the plants will not reappear.

STUDIES OF FISH DISEASE.

The position of fish pathologist in the Bureau was vacant during the last half of the fiscal year, the last incumbent having left the service at the end of December after a year's service. Some studies of diseases and parasites were also conducted by other investigators principally in temporary employ.

MORTALITY IN PIKE-PERCH EGGS.

The great losses in the hatching of pike-perch eggs have made this phase of fish culture a ground of repeated inquiry, although as yet no investigation has been carried to a conclusion revealing the exact causes of the high death rate. Further observations during the past fiscal year were made by Dr. Franz Schrader, who inquired into the practices of handling fish and eggs and investigated the actual changes taking place within the abnormally developing eggs. His observations point to the conclusion that the original cause of abnormal development and mortality of eggs is to be sought in physiological injuries sustained by the parent fish while held in captivity before spawn can be taken. The penning of fishes prior to spawning is a practice of long standing in the artificial propagation of pike perch and other species of fish. Some species withstand the confinement very well, while others manifest such ill-effects as hardening of ovaries, wateriness of milt, and low percentage of hatched fry—in short, degeneration of eggs and sperms. The general inference of the investigator finds some confirmation in the investigations reported in the next paragraph and also in the experiences of several superintendents who have observed that the mortality of pike-perch eggs is proportional to the length of time the fish have been retained in pens, and conversely, that the percentage of hatch is greater in the case of eggs from fish stripped as taken from the nets than in the case of eggs taken from fish that have been held in pens.

ABNORMAL CONDITIONS OF FISH OVARIES.

Dr. Schrader also conducted inquiries into ovarian conditions in fishes with the purpose of throwing light upon various difficulties arising in hatcheries, including the loss of spawning fishes, ovarian diseases, and failure of fertilized eggs to hatch, troubles which possibly have some relation to abnormal conditions of confinement, handling, or stripping. Observations were made upon developing immature eggs of the scup, the retention of eggs beyond the normal period of spawning, the reabsorption of retained eggs, and the hardening of ovaries. Abnormally retained eggs show signs of degeneration in course of one or two weeks. Reabsorption takes

place through invading cells, but is not always successfully accomplished; it apparently makes a demand upon the body of the fish, which, if excessive, may lead to death.

DISEASE OF RESCUED FISH.

Dr. H. S. Davis, temporary investigator at the Fairport biological station, has found that a high mortality may occur among rescued fishes immediately after the handling incident to rescue operations. This heavy death rate is especially characteristic of the crappies, buffalofish, and bluegills, when taken in warm weather, the first-named species being the weakest. While the mortality may be founded in part upon "shock" sustained during the seining and handling operations, it is due more directly to bacterial infection following slight injuries and gaining headway from the weakened condition of the fish. Immersion for one minute in a solution of copper sulphate in 1 to 1,000 dilution reduces the loss among rescued fishes to a minimum.

In certain experiments 75 to 100 per cent of the crappies rescued from inland sloughs and untreated were lost through death. Under similar conditions, except for a one-minute treatment with 1/1,000 copper-sulphate solution after the fish were allowed to remain a short time in fresh clean water, this experimental loss was reduced to 30 or 40 per cent. The necessity and practicability of the treatment depend upon the conditions attending work in particular fields and at particular times. It is believed that frequent tests should be made in connection with rescue operations and the prophylactic measures taken wherever a substantial mortality rate is to be expected. Dipping in a simple disinfectant can not be very expensive and will be worth while if it will increase appreciably the percentage of survivors.

Dr. Davis's experiments not only point out the possibilities of loss and the means of prevention, but they also emphasize the necessity for great care in handling rescued fish. Rough methods, including the throwing of fishes into receptacles and the abrasion of the fishes' bodies by seines, hands, or débris are the main causes of a high death rate.

PARASITIC FLATWORMS OF FRESH-WATER FISHES.

The parasitic flatworms which infest the body surface and gills of fishes (ectoparasites) may be more of a nuisance to fish culture in ponds, tanks, or aquaria than those which live within the body of the fish. The endoparasites generally can not complete the life cycle without passing different stages in two or more hosts, which are likely to be animals of widely different groups. Therefore, as regards these parasites, fish can not directly infect fish. With external parasites it is otherwise; there being no alternation of hosts, infection may proceed from fish to fish and thus multiply in such abundance as to cause extreme weakness or death of the fish. Such a parasite is *Gyrodactylus fairporti*, a new species described by Dr. H. J. Van Cleave from bullhead and carp of certain ponds at the Fairport (Iowa) station. These flatworms are very small, usually

less than half a millimeter in length, and so translucent that one may easily overlook them.

Some bullheads removed from a quarry pond near the Mississippi River died within 24 hours after being placed in an aquarium of running water. The early death of these usually most hardy fish could be explained only on the supposition that their vitality had been greatly diminished by the small and abundant trematodes (*Gyrodactylus*) scattered over the entire surface of the body. Possibly many fish in the river are unfavorably affected by these worms.

Dr. Van Cleave found a species of another genus of parasitic flatworms upon the gills of sunfish, black bass, and channel catfish, but it is believed that worms of this genus (*Ancyrocephalus*) do not cause dangerous infestations.

Very little study has been devoted to the ectoparasitic flatworms on this continent, and previously but four species have been reported from fresh-water fishes. Much attention has been given them in connection with fish culture in Europe. Treatments which European writers have recommended are: (1) A one-fourth of 1 per cent solution of salicylic acid, in which the fish remains half an hour (Hübner); and (2) a solution of 1 part of potassium permanganate to 100,000 parts of water. The treatments may require modification for our species of fish and of parasites.

Dr. Van Cleave has also described a new genus of trematodes based upon specimens taken from the white bass, *Roccus chrysops*, collected in Iowa, Illinois, and Minnesota. The parasites were found only in the digestive tract and at present are ascribed no economic significance. The parasites are not found in *Morone interrupta*, although that species is a close relative of the white bass. He finds, indeed, that the trematode parasites of the yellow bass are entirely distinct from those of the white bass, although the two related species display marked similarity in range, local preference, feeding habits, and food.

TREATMENT OF ICHTHYOPHTHIRIUS DISEASE.

One of the most troublesome external parasitic affections of fresh-water fishes in aquaria and ponds is due to a microscopic protozoan (*Ichthyophthirius*), which becomes embedded in the skin and sets up a violent irritation. H. L. Canfield, superintendent of fish culture at the Fairport station, who has conducted experiments in the treatment of channel catfish heavily infected with the protozoan parasite, reports that commercial carbonate of soda in the form of sal soda (washing soda) is effective in alleviating the trouble.

Using a receptacle other than metal to hold the solution, 150 g. of sal soda are placed in 4,000 c. c. of water, in which solution the affected fish are dipped. The diseased fish are held in troughs of lively running water, which aids in the treatment and facilitates handling. Before each treatment the fish are forced to the lower half of the trough, where they are separated from the upper half by means of a cross screen. The diseased fish are caught in a hand net, immersed in the solution until they show signs of discomfort (darting about), and then placed in the fresh water at the upper end of the trough. This process is continued until a material reduction in parasites is noticed

(usually about six days), after which the treatment is given once a day for about 10 days, which is usually sufficient to rid the fish of the parasites.

The effect of the sal-soda solution is to cause the parasites to shrink and wrinkle as they die. It is apparent that the solution kills the free swimmers, the young just attached to the fish, and all but the larger and more thoroughly embedded parasites. These last leave the fish in the natural process of development, and their offspring are killed with others after they attack the fish and before they attain their maturity. Thus in time the parasites are entirely exterminated.

The channel catfish were fed, as usual, ground liver three times a day while the treatment was in progress, and the usual care was given the fish and troughs as to cleanliness.

OCEANOGRAPHIC AND LIMNOLOGICAL STUDIES.

INVESTIGATIONS IN THE ATLANTIC.

Because of deficiency in funds and personnel the *Albatross* has not been at sea during the year.

Some brief cruises to complete the field work of the hydrographic and biological survey of the Gulf of Maine were made by the small Fisheries steamer *Halcyon* under the direction of Dr. H. B. Bigelow. The preparation of the report upon all the data gathered at different times during a period of years is now in progress, although its completion has been delayed by the death of William W. Welsh, who was giving special attention to the portion of the report dealing with the occurrence, distribution, and life histories of the fishes.

By joint action of the Governments of the United States, Canada, and Newfoundland there has been formed during the year an International Committee on Marine Fishery Investigations, with the object of bringing about a better correlation of the activities of the several Governments in fishery investigations in which two or more of the countries are directly interested. Knowledge of the cod and the conditions of its perpetual conservation, for example, possesses the same interest to Canada and Newfoundland as to the United States. No formal cooperative effort is contemplated, but it is believed that progress will be attained more rapidly and economically by regular interchange of data and counsel than by entirely detached endeavor on the part of each nation. The members of the committee are as follows: For Canada, Mr. William A. Found, Assistant Deputy Minister of Fisheries; Dr. A. G. Huntsman, member of the Biological Board of Canada, and Mr. Loring C. Christie, legal adviser, Department of External Affairs, Ottawa; for Newfoundland, Mr. D. James Davies, chemist to the Newfoundland Government; for the United States, Dr. H. F. Moore, Deputy Commissioner of Fisheries, Dr. R. E. Coker, assistant in charge, scientific inquiry, Bureau of Fisheries, and Dr. H. B. Bigelow, consulting oceanographer, Bureau of Fisheries.

The first meeting of the committee was held in Montreal, June 23, 1920, when, after full discussion, agreement was reached as to correlation and interchange of statistical data with regard to particular fishes, uniformity in methods of plankton study, and concentration of attention upon certain species.

SURVEY OF CHESAPEAKE BAY.

The biological and hydrographic survey of Chesapeake Bay has been continued by Dr. R. P. Cowles, temporary investigator, during the past year, and a large series of data on salinity, temperature, current velocity, and current direction has been accumulated, together with qualitative and quantitative collections of plankton, bottom samples, and many specimens of the larger animals and plants. The observations made and samples collected have not been confined merely to the surface nor to the bottom but have been obtained at definite depths, equal intervals apart, from the surface to the bottom. Probably the most valuable characteristic of the work is the fact that the observations have been made about every sixth week during the year at fixed stations arranged in lines across the bay, these lines being so placed as to adequately cover the bay from the region of Baltimore to the Capes. The Fisheries steamer *Fish Hawk* has been employed in the work on the bay.

During the year preliminary work has been undertaken to determine the hydrogen ion concentration of the sea water by colorimetry. This method has now been perfected, and the tests made on the so-called 24-hour stations, where observations are taken every 1½ hours at definite intervals from the surface to the bottom for a period of 24 hours, have shown some very interesting conditions.

The coming year will be devoted to working over the data and material, with possibly an occasional cruise on the bay to collect information that may be lacking. The general purpose of the investigation is to gather and record the data that are necessary for the interpretation of the seasonal and irregular movements of fishes, for the solution of practical problems that arise from time to time regarding fish and shellfish, and for the conservation and development of the important fisheries of the bay.

This general survey is being supplemented by a special investigation of fishes of the Chesapeake Bay, conducted by S. F. Hildebrand and W. C. Schroeder. While many fishes, especially the younger examples of several species, have been collected in connection with the general survey, the supplemental field work on fishes was undertaken only in the last months of the fiscal year.

SURVEY OF SELECTED AREAS IN MISSISSIPPI RIVER.

In an investigation to determine the distribution of fresh-water mussels, Dr. A. D. Howard made a somewhat detailed study of the entire bottom in a portion of the Mississippi River, the area selected being 3 miles in length and situated in Andalusia Chute, one of the channels of the river in the vicinity of Fairport, Iowa. The river in this section is comparatively straight and of rather uniform character as to gradient and depth, passing over soil of clay, sand, and sedimentary rock (mostly limestone).

The life on the bottom was found to have a rather definite distribution with reference to physiographic features of the river. In general it was restricted to a zone 200 feet wide along each shore. Where islands occurred a narrower zone was found along the shores of the islands. The distribution had apparently no particular relation to depth of water, for the middle area of the stream (about 500

feet wide) was not deeper than the 200-foot strips alongshore. The zones near shore are by no means equally productive throughout, the more densely populated portions manifesting definite relations to the position of the channel and to other features of the stream, especially those that affect the stability of the bottom. Productive areas usually occur in parts of the shore strips that are bathed by the current, or where the channel approaches the shore. Character of bottom soil is a significant feature, but this is often controlled by current, topography, and other conditions.

Keokuk Lake, formed in the Mississippi River above the dam at Keokuk, has been examined some years after its formation to determine some of the effects of the changed conditions. A report of the observations is in process of preparation.

STUDIES OF INLAND LAKES.

The Bureau has continued to cooperate with the Geological and Natural History Survey of Wisconsin in biological and chemical investigations directed at the fundamental problems of the capacity of inclosed waters for support of fish life. As has hitherto been stated, the Bureau bears only a relatively small proportion of the expense of the investigation. Substantial progress has been made, as is indicated by the following outline submitted by President Edward A. Birge and Chancey Juday representing the State Survey:

1. The bulletin dealing with the quantity and chemical composition of the plankton of the lakes situated in the vicinity of Madison is now ready for the press. During this investigation 481 observations have been made on the net plankton and 182 on the nanoplankton of these lakes, making a total of 663 catches. These catches were combined into 374 samples for the chemical analyses. About 2,500 separate chemical and ash determinations have been made on these samples and 52 samples of special material obtained during the progress of this work.

The quantity of dry organic matter in the total plankton of Lake Mendota (net plankton plus nanoplankton) varied from a minimum of 230 pounds per acre in February to a maximum of 521 pounds per acre in December in the area situated within the 20-meter contour line. When the surface of the entire lake and the volume are taken into account the range is from 126 pounds per acre in February to 256 pounds in December. The live weight of the organic matter is 10 times as much as the dry weight.

Of the dry organic matter an average of 44.5 per cent consisted of crude protein, 7.5 per cent ether extract, and 5.3 per cent crude fiber, leaving 42.7 per cent to be designated as nitrogen free extract (chiefly carbohydrates). The pentosans were the only carbohydrates studied, and they constituted an average of 4.6 per cent of the organic matter.

Lakes Monona and Waubesa yielded larger quantities of total plankton. The amount in the former varied from a minimum of 276 pounds per acre in July to a maximum of 1,063 pounds of dry organic matter in October in the area bounded by the 20-meter contour. For the entire lake the range was from 111 pounds to 426 pounds per acre of surface. The maximum crop of plankton in Lake Waubesa yielded 862 pounds of dry organic matter per acre in the area bounded by the 10-meter contour, or 415 pounds per acre for the entire lake; the average for 16 samples is 216 pounds of dry organic matter per acre.

The dry organic matter in the total plankton of Lake Monona contained 57.5 per cent of crude protein, 4.8 per cent of ether extract, 4.7 per cent of pentosans, and 4.4 per cent of crude fiber. The total plankton of Lake Waubesa yielded an average of 48.6 per cent of crude protein, 4.6 per cent of ether extract, 5.8 per cent of pentosans, and 4.4 per cent of crude fiber.

2. Mr. Wilson's numerical results for the bacteria of Lake Mendota show that the average number from surface to bottom in 23.5 meters of water was 3,000 per c. c. of water in July and August, 1919; in the following autumn and

winter the number fell to 1,500 per c. c. In the spring and early summer of 1920 the number rose steadily to a maximum average of about 30,000 per c. c. from the latter part of June to the end of August. During the autumn and early winter the number gradually declined to an average of 2,000 bacteria per c. c. of water.

Many of the bacteria represent chromogenic forms, and various colors are found in the plate cultures. There seem to be some denitrifying individuals present, but conclusive evidence of the presence of lime-precipitating forms has not been obtained yet. The average size of these bacteria has been obtained so that it will be possible to estimate their live weight and dry weight as well as the organic matter in them.

3. Several reports are now in press in the Transactions of the Wisconsin Academy which deal with investigations in which the Bureau of Fisheries has cooperated. The following may be listed here: "A survey of the larger aquatic plants of Lake Mendota," by R. H. Denniston; "A quantitative study of the larger aquatic plants of Lake Mendota," by H. W. Rickett; "A quantitative study of the bottom fauna in the deeper water of Lake Mendota," by C. Juday.

Some chemical analyses of the larger aquatic plants from Lake Mendota have also been made, but this has been done independently by the Wisconsin Survey.

4. Various analyses have shown that the quantity of organic nitrogen in the lake water itself amounts to five or six times as much as that in the total plankton, and Dr. Schuette has been trying to work out a method for the determination of this dissolved organic nitrogen which will give results that are more satisfactory than the present methods of nitrogen determination. The quantities are so small that the methods now used by chemists do not always give consistent results. So far no other method has been found which will give better results than the standard methods.

AGAR-AGAR AND OTHER GELATINS FROM SEAWEED.

It is obviously unfortunate that the United States should be dependent upon other countries for its supply of a vital necessity. Agar-agar is the commercial name applied to a gelatinous product which has been imported from Japan, China, and other places, the importations in 1919 amounting to nearly half a million dollars. The importance of the material is not, however, measured by its strictly commercial value. While it is used in making food and confections, agar-agar is primarily important because it is a necessary medium for bacteriological work, and is therefore essential to medical laboratories and hospitals. It is a requisite for certain industries, for the maintenance of health, and for national security.

Marine algæ or seaweed have long been used in this country for the preparation of gelatins for particular purposes, but only the recent investigations, conducted for the Bureau by Dr. Irving A. Field,⁹ have revealed the fact that we have possible sources of supply for the most valuable gelatin of all in certain species of seaweed on the west coast. In the report for the preceding year reference was made to Dr. Field's preparation of a gelatin suitable for use in preserving fish, and to experiments in producing a substitute for agar from Atlantic coast seaweed. These experiments were not successful, but it was later ascertained that at least one species of the west coast yields agar of the best quality. Agar prepared by Dr. Field and tested at the Army Medical School in Washington was pronounced equal or superior to the imported agar. Another species yielded a product apparently of like quality. The investigation should be followed by a field survey for the purpose of definitely locating the

⁹ Field, I. A.: Sources, Preparation, and Properties of Some Algal Gelatines. Bureau of Fisheries, Economic Circular No. 51, issued Oct. 10, 1921, 7 p. Washington.

sources of supply. It was a serious misfortune that Dr. Field died shortly after completing and reporting upon his laboratory investigations.

THE OYSTER.

INVESTIGATIONS OF OYSTER CULTURE.

The investigation of oyster problems of Great South Bay and Long Island Sound was continued according to the general plan of the year before. The work was begun by Dr. E. P. Churchill, assisted by J. S. Gutsell, but Dr. Churchill left the service in August and thereafter Mr. Gutsell continued it alone. Quantitative collections and studies were made with the aid of the pumping equipment and selective screens developed by the Bureau investigators.

At Great South Bay the plan comprised chiefly an intensive study of the distribution, life, and setting of the oyster larvæ. At fixed stations located over a considerable area of the best oyster grounds in the bay quantitative collections were made as in 1919. In that year it had been found that certain of these stations were almost uniformly superior to others in their yield of larvæ, and that the set at these stations was correspondingly more abundant. The work in 1920 was planned to check up and enlarge on this evidence, to see if the general distribution of larvæ was much the same year after year. Addition to our knowledge in other aspects was, of course, to be included.

Unfortunately the season was a poor one. Oyster larvæ until after mid-July occurred scatteringly, at best in small numbers. The conditions indicated a very light set indeed. The one station which showed decided superiority was not located over oyster beds and offered no opportunity of determining a set. A return visit with inadequate apparatus late in August showed young oyster larvæ in apparently fair abundance and indicated an unusually late spawning and a possible late set.

In accordance with the scarcity of larvæ, a very light set was found in the fall; and corresponding apparently to the late spawning, a set was found in the spring which had not attained sufficient size in the fall to be noticeable. In general these sets were so light as to be commercial only to the extent of having sufficient value to repay shifting.

Thus support was given the hypothesis that a relation can be found between the observable abundance of larvæ and the amount of set, and that consequently a scarcity of larvæ indicates that the great expense of "shelling" should be avoided.

In Long Island Sound, where the oysters spawn later than in Great South Bay, the work was curtailed by the reduced personnel and was limited chiefly to the region between Milford and Bridgeport. Collecting was poor indeed except for a time in August, when moderate numbers of larvæ were obtained, particularly about Bridgeport. Something of a set was later reported there. Thus in the Sound, as in Great South Bay, there was little opportunity that season to obtain other than negative evidence as to the relation of the occurrence of oyster larvæ and the abundance and location of set.

The study, made in cooperation with the Bureau of Chemistry, of the trade-waste problem in its relation to oyster culture was continued. Before he left the Bureau Dr. Churchill performed experiments with various dilutions of standard solutions of chemicals known to occur in or to be discharged into water near oyster beds. He found the larvæ very sensitive, certain chemicals being fatal even in great dilutions. In Bridgeport Harbor late in the season samples were collected for the determination of the distribution of injurious wastes, particularly the heavy metals. As a result of the study of this harbor and of the efforts of the two bureaus, the company, which discharged much the greatest amounts of copper, was persuaded to install an electrolytic recovery process, which has given great promise both as a money saver and as a means of improving harbor conditions.

In June, 1921, the spawning of oysters in Great South Bay has been found to begin in earnest almost a month earlier than in previous years of our experience and to occur at decidedly lower temperatures. The work is being so carried on as to check up the data obtained in 1919, and already the larvæ have been found to be much more widely distributed in good numbers. In addition, as opportunity permits, data are being gathered to test out the hypothesis advanced by Dr. T. C. Nelson that oyster larvæ of the larger sizes keep from being washed to sea by sinking with the ebb tide and rising with the flood.

The study of the development and distribution of the larvæ is of interest to local oystermen and has, it is believed, influenced them in determining the times, places, and extent of planting shells for set. The immediate purpose of the Bureau, it must be understood, is to determine the possibilities of the method of larvæ survey in obtaining best results and effecting economies in planting and in the prevention of costly wastes from planting in seasons when a set is not obtainable. Once a satisfactory demonstration is obtained, the method can be applied in other localities as well as at the places where the experiments have been conducted.

EFFECT OF POLLUTIONS UPON PROPAGATION OF OYSTERS.

Pollutions may affect oyster eggs and larvæ, either directly, by the toxic effect of certain chemicals upon the young oysters, or indirectly, through the exhaustion of the oxygen supply and partial or complete suffocation of the larvæ. The latter aspect of the problem was given attention by Dr. P. H. Mitchell, director of the Woods Hole (Mass.) Fisheries laboratory.

In experiments on the effect of oxygen deprivation on oyster larvæ Dr. Mitchell found that while the embryos are sensitive to diminished oxygen supply a number of factors affect the lower limit of the oxygen content of water compatible with life of the larvæ. The factors noted were: (a) The previous history of the eggs from which the larvæ were hatched, for example, ripeness at the time of artificial fertilization and previous exposure to pollution; (b) the age of the larvæ; (c) the carbon-dioxide content of the water; (d) the hydrogen ion concentration of the water; and (e) the temperature.

Development of a satisfactory technique for handling such unusually sensitive and perishable material as oyster larvæ, in the

manipulations required for this experiment, consumed much time. Consequently the end of the breeding season for oysters came before there was opportunity to work out the relations of all these factors in an entirely quantitative manner.

Results may be summarized as follows:

With regard to the condition of the eggs, it was observed that embryos from eggs of which 50 per cent or more developed quickly to a free swimming stage withstood deprivation of oxygen better than those from eggs of which only a small proportion developed.

With respect to age, it appeared that younger larvæ endured comparative oxygen deprivation slightly longer than older ones, but the experiments were not conclusive.

It was found that embryos show some effect of oxygen lack in water containing 25 per cent of saturation of oxygen at 24° C. and a markedly increased mortality in 10 per cent of saturation. Killing time varied from 12 to 30 hours according to extent of oxygen depletion. At 28 to 30° C. embryos die much more rapidly from oxygen starvation than at 22 to 24° C.

Carbon dioxide seems to have a toxic effect other than that due to hydrogen ion concentration. Embryos died earlier in water containing sufficient oxygen but excessive CO₂ than in water of the same oxygen content and with the same P_H obtained by adding lactic acid.

Investigation of the effect of pollution on satisfactory development of eggs in gonads was also conducted. Results showed that from oysters, kept 7 to 10 days in water polluted so as to markedly lower its oxygen content, only an abnormally small proportion of eggs could be made to develop after artificial fertilization, conducted according to standardized technique, and that the embryos so obtained did not develop as far as controls.

An incidental observation proved of considerable interest. Oysters which had been in cold storage 24 days for the purpose of studying greening were found to have very full gonads. Eggs fertilized with sperm from some of the same lot of oysters developed satisfactorily, and many of the embryos reached the primitive shell stage. Some of them, indeed, were used in oxygen-requirement tests.

Observations on the cause of copper greening confirmed previous conclusions by showing that not only the amount of copper obtainable by the oysters, but also conditions of habitat determine whether or not visible green spots occur. Marked appearance of greenness after one or more weeks in cold storage was observed. It has been twice noted that with gonads filled a smaller proportion of oysters become green during storage than in other conditions. Two-year-old spent oysters, set and reared in Wareham River, did not become green during four weeks in cold storage. This is in contrast to oysters which at some time during their previous history have been in waters known to produce greenness (near Bridgeport and New Haven).

Experiments both in the laboratory and in the field indicated a positive influence of diminished oxygen supply in causing the appearance of green spots. Repeated observations of marked greening of oysters in polluted tanks of sea water were also made, thus confirming the similar results obtained during the previous summer in the Seekonk River.

FRESH-WATER MUSSELS.

PROPAGATION OF MUSSELS.

The Fisheries biological station at Fairport, Iowa, continued its practical propagation of fresh-water mussels in the Mississippi drainage at Lake Pepin and Lake Pokegama, Minn.; at New Boston, Oquawka, and Dallas City, Ill.; at Fairport, Iowa; at Hannibal and Clarksville, Mo.; and in cooperation with rescue crews along the Mississippi in Wisconsin and Minnesota. The total number of glochidia infected upon fish and liberated in public waters during the year was approximately 648,445,000, including 478,705,000 infected upon rescued fish by cooperative agents working in connection with rescue crews of the division of fish culture.

With a view to demonstrating the possibilities of mussel propagation in connection with the rescuing of food fishes, the National Association of Button Manufacturers offered to cooperate with the Bureau by providing men to accompany each rescue crew on the upper river and to inoculate all fishes with the glochidia of the Lake Pepin mucket, the most important of the local mussels. Seven agents of the button manufacturers cooperated with seven crews working under the direction of Supt. Culler, of the Homer (Minn.) station, and during October and November inoculated nearly 6,000,000 fish with glochidia.

The localities in which the work was done and the number of fish subjected to infection in each locality were as follows:

Lynxville, Wis.....	2,025,200
Genoa, Wis.....	1,214,900
Ferryville, Wis.....	907,340
Fountain City, Wis.....	86,510
North McGregor, Iowa.....	676,100
Belleue, Iowa.....	931,500
Total.....	5,841,550

Material cooperation of this nature by an association of business men is a source of gratification to the Bureau, not only as evidence of a cordial spirit, but as evidence of faith in the practical value of the service rendered in the propagation of river mussels.

PROTECTION OF MUSSELS.

A prominent feature of the work of the Fairport station for several years has been the part which it has played in bringing about a strong sentiment for the protection of fresh-water mussels and the cooperation it has extended to the several States in giving aid, when solicited, in selecting the areas for closure to mussel fishing. Additional closures of streams or parts of streams has followed the beginning made in the past by Minnesota and Wisconsin. Minnesota in April closed for a period of five years parts of the Minnesota River, and the entire Cannon and Straight Rivers. Iowa, in the same month, closed for a similar period parts of the Iowa, Cedar, and Des Moines Rivers, and the entire Shellrock River.

MUSSEL SURVEY IN UPPER MISSISSIPPI RIVER.

During the months of July and August, 1920, the Bureau of Fisheries made a study and appraisal of the mussel resources in a portion of the upper Mississippi River, beginning at a point about 5 miles above Red Wing, Minn., and extending down through Lake Pepin, a distance of about 80 miles, to Lamoille, Minn. The work was undertaken with reference to recent administrative action on the part of the States of Wisconsin and Minnesota providing for the closure of certain areas for the protection of the fresh-water mussels while permitting the fishery to continue in alternate open areas. The data acquired in this investigation are expected to establish a basis for comparison of conditions before and after a period of protection. The investigation was conducted under the Fairport biological station by Dr. N. M. Grier, with two assistants. Observations were made in five open and five closed areas.

Many data were secured regarding the depletion of formerly productive areas of mussel fishery, the diminution in abundance of mussels in different beds being attributed variously to the indirect effects of the construction of wing dams as aids to navigation, to excessive fishery, and perhaps in some cases to the dumping of rubbish in the river in the vicinity of cities.

The information gained will serve also as an aid to the Bureau in the conduct of mussel propagation for the rehabilitation of depleted and protected areas.

EXPERIMENTS RELATING TO MUSSEL PROPAGATION.

Experiments in retaining in inclosures fish artificially infected with glochidia of the Lake Pepin mucket, *Lampsilis luteola*, have been continued in Lake Pepin by Roy S. Corwin, scientific assistant. It was found in certain experiments that pike perch infected as late as August 19 carried glochidia until the following May, and that mussels during the second year of growth will thrive in an inclosure with a density of 18 mussels to the square foot. Third-year mussels with eight to the square foot flourished and showed an average increase in length of more than 100 per cent in one year.

Artificial infections of the Lake Pepin mucket on pike perch retained in a fine-meshed inclosure in the lake yielded an average of 833 juvenile mussels per fish. Assuming that these fish bore the usual infection of about 3,000 glochidia per fish, the yield of young mussels was 27.4 per cent. This is a much higher percentage than has ever been assumed to result from practical operations in artificial propagation of mussels.

Dr. L. B. Arey continued his study of the encystment of the glochidia of the fresh-water mussel. It has been established that the tactile response of the glochidium alone is adequate to insure attachment. The view that glochidia regularly attached to the host through a chemical activation by blood, derived from gill hemorrhages, appears to be untenable. Cyst formation is not initiated or controlled by any vital influence of the glochidium. It has been induced by the application of tiny metallic clips to a gill filament.

INVESTIGATIONS IN THE KENTUCKY RIVER.

Prior to 1919 the Kentucky River was an unworked and practically unknown mussel stream. In the summer and autumn of 1919 and the summer of 1920 the upper part of the river was investigated by Ernest Danglede, temporary assistant. Preliminary tests were made in the summer of 1919 which indicated that good marketable shells were to be found in the headwaters, and encouragement was offered to various people who had expressed a desire to engage in mussel fishing. As a result, by the middle of July, 1919, two mussel camps were established in the upper courses.

The river was examined from near its source down to Beattyville, Ky., below which place the stream contains many locks and dams and is unsuitable for mussel fishing. In the upper parts of the stream, in the north and middle forks, numerous but small beds were encountered. Fourteen were investigated and are described in some detail in a report on file with the Bureau. Forty species of mussels were obtained, of which 22 have commercial value, the mucket being the most important. Upper Twin Shoals is remarkable for the abundance of young muckets.

THE BIOLOGICAL LABORATORIES.

The Woods Hole (Mass.) laboratory, Dr. P. H. Mitchell, director, was in operation with a limited staff during the summer of 1920. Previous mention has been made of the investigation relating to oysters and the preparation of commercial gelatins from seaweeds. Prof. Edwin Linton continued investigations of the food and parasites of fishes, and Prof. William W. Browne was engaged in completing his report upon the nature and causes of the reddening of salt fish. Because of the unavoidable limitation of the Bureau's activities, it was found impracticable to open the laboratory for the summer of 1921.

Beaufort (N. C.) laboratory has been virtually closed during nearly the entire fiscal year. Since the director, R. L. Barney, was necessarily transferred early in the year to another station, the laboratory has been without scientific direction. Mr. Barney has, however, completed a general report on the natural history and culture of the diamond-back terrapin, embodying the information available from observations and experiments as relating to growth and reproduction of wild and domestic stock, care of young and adults, feeding, housing, and hybridization. Further attention has been given to the study of the bacterial disease which has been the only serious disease affecting winter-fed terrapin. Under the superintendence of Charles Hatsel, terrapin experiments have been continued, the grounds of the station have been kept in good condition, and the buildings in such repair as was possible with the available funds.

At the Fairport (Iowa) biological station the new laboratory building was completed and occupied early in September, and shortly thereafter R. L. Barney was appointed director of the station. In response to an outside demand, the laboratory building was formally dedicated October 7. A large number of prominent persons, including scientists representing the leading universities of the country,

participated both in the exercises of dedication and in the conference on the following day, which gave consideration to the natural resources of interior waters and the possibilities of their utilization and conservation.

The interest manifested in that conference and the demonstration it afforded of the possibility of bringing about better cooperation in the conservation of aquatic resources led to a call by the Secretary of Commerce of a conference of more extended duration to meet at the station June 8 to 10, 1921. On this occasion there were in attendance about 125 persons, including biologists, chemists, sanitarians, fishermen, manufacturers, fish-culturists, game wardens, engineers, and others. During the three days of the conference there was free and informal discussion related to the three major topics suggested in the call for the gathering, viz: The depletion of aquatic resources, causes, and remedial measures; the value of swamp and shore areas and their best utilization; and a constructive program of conservation. Interest was sustained throughout, and the conference adjourned only after recording a request that a similar meeting be called the following year.

The special activities of the Fairport station have been treated under several preceding heads; investigation of the paddlefish, fish-cultural experiment work, studies of fish disease, survey of selected areas in the Mississippi River, and fresh-water mussels. The station frequently also performs services of value to fishing clubs, private hatcheries, and individual owners of lakes and ponds, furnishing advice regarding the stocking and control of ponds and aiding in the solution of such troublesome conditions as may arise. The value of these advisory services is founded upon the scientific research conducted at the station and the experience gained in propagating and rearing fish under conditions of control.

The Key West (Fla.) biological station has been without a director from the beginning of the fiscal year until within a few days of the close of the year, when the services of a competent scientist were secured for a temporary period. During the greater part of the year the station has been in the hands of a caretaker. No further constructions have been undertaken, but the grounds have been suitably fenced for protection, and some plantings of appropriate vegetation have been made.



DEPARTMENT OF COMMERCE
BUREAU OF FISHERIES
HUGH M. SMITH, *Commissioner*

PROPAGATION AND DISTRIBUTION OF FOOD FISHES, 1921

REPORT OF THE DIVISION OF FISH CULTURE
FOR THE FISCAL YEAR 1921

By GLEN C. LEACH
Assistant in Charge of Fish Culture

APPENDIX IX TO THE REPORT OF THE U. S. COMMISSIONER
OF FISHERIES FOR 1921



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INTRODUCTION.

In considering the value of any branch of governmental work it is clearly just to take cognizance of the progress made, as evidenced by an increased volume of work, but improved methods and lower costs of producing and distributing the output are, in the case of fish culture, of more importance, as indicating efficiency and sustained interest in the work.

For a number of years there has been no increase in the funds provided for the propagation and distribution of food fishes, and only the very inadequate increase in compensation of faithful employees as provided by the so-called bonus of \$240 per annum. In the face of this condition and the fact that the cost of all commodities, labor, and railroad rates increased many fold during the period of the World War, it is particularly gratifying to note that the bureau maintained its fish-cultural establishment, if not intact, still at a point of efficiency where it handled an increased volume of work without material increase in the cost of production or distribution.

The value of modern fish culture is so generally accepted by those having knowledge of the facts as to need no defense and is shown by the action of many States in providing funds for such work, by the numbers of fish-cultural plants financed by commercial interests, and by individuals who are interested only in maintaining the fish supply in a given locality.

The bureau's fish-cultural division is probably more completely organized and equipped than any similar institution in the world. It has been built up through a long period of years and represents the thoughtful and painstaking effort of many persons. It has reached a point in its history where its movement must either advance or retrograde. To longer maintain the present magnitude of the work with the funds provided is manifestly impracticable. On the other hand, the opportunities for its continued enlargement and extension are restricted only by the facilities available.

During the fiscal year ended June 30, 1921, 62 per cent of the appropriation provided by Congress for the propagation and distribution of food fishes was expended in the maintenance and development of the commercial fisheries.² The remaining portion of the fund was devoted to the equally important, though less extensive, work of producing and disseminating in the interior waters of the country various species of trout and the so-called warm-water fishes, including the black basses, crappies, and sunfish. The widely extended and rapidly increasing use of the automobile has opened to tourists and sportsmen numerous trout and bass waters which were formerly inaccessible, with the result that interior streams and lakes in all parts of the country have been heavily overfished. Of all fishermen concerned automobilists as a class are perhaps the most law-abiding, but their rapidly increasing numbers and their habit of camping near a promising body of water and fishing it for an extended period—sometimes for several days—has constituted a drain which it will not be easy to make good. A most serious aspect of the situation is that it threatens the resources of waters which have never heretofore required any appreciable effort on the part of either Federal or State agencies to maintain. The greatest danger in this respect lies in the Western mountain States, in New England, and in other parts of the country which abound in natural scenic beauty.

The situation is a grave one, and if not given proper and immediate attention by the States concerned and by the Federal Government there is imminent danger of the total depletion of fish life in many valuable waters which have heretofore yielded an abundant supply. The advantages of keeping the interior waters of the country well stocked with the game and food fishes adapted to them are many and obvious. By such means a cheap and very desirable food supply is afforded to a certain class of people who would otherwise be unable to enjoy it. Vast numbers of people are inspired by the lure of good fishing to seek the great out-of-doors, with very beneficial results to their health, aside from the recreation afforded. Certain of the State authorities who are not able to cope with the difficulty have applied to the Bureau of Fisheries for aid, but in most instances it could not be given, the bureau's resources having been already greatly overtaxed in the effort to maintain the scope of its work along previously established lines.

The bureau's efforts in fish culture are directed chiefly toward the maintenance of the existing fisheries of the country and toward the development of new and profitable sources of fish supply by extending its operations over a wider territory in fields contiguous to the present stations. Five important functions are involved in this work, namely, the collections of eggs from various species of fish of economic value, the incubation of the eggs in properly equipped hatcheries, the rearing and feeding of the young of certain species, the rescue of stranded fishes from overflow waters in the Mississippi Valley, and the distribution of fish and fish eggs in suitable waters.

² The expenditures involved in distributing the output of the hatcheries represents approximately 17 per cent of the total appropriation, and 30 per cent of this amount represents the expenditures in connection with the commercial species.

Part 1.—FISH PROPAGATION AND RESCUE.

Summary of Operations.

SPECIES OF FISHES HANDLED.

During the fiscal year ended June 30, 1921, the bureau propagated and distributed some 48 species of fishes, as shown in the following list. Fishes rescued from overflowed lands in the Mississippi Basin and restored to original waters or distributed in other sections of the United States are included.

LIST OF SPECIES HANDLED.

THE CATFISHES (SILURIDÆ):

- Horned pout, bullhead (*Ameiurus nebulosus*).
- Marbled catfish (*Ameiurus nebulosus marmoratus*).
- Mississippi catfish (*Ameiurus lacustris*).
- Spotted catfish, channel catfish (*Ictalurus punctatus*).
- Yellow catfish (*Leptops olivaris*).

THE SUCKERS (CATOSTOMIDÆ):

- Mongrel buffalofish (*Ictiobus urus*).
- Common buffalofish (*Ictiobus cyprinella*).
- Smallmouth buffalofish (*Ictiobus bubalus*).

THE CARPS (CYPRINIDÆ):

- Asiatic carp (*Cyprinus carpio*).

THE SHADS AND HERRINGS (CLUPEIDÆ):

- Shad (*Alosa sapidissima*).
- Glut herring (*Pomolobus aestivalis*).
- Skipjack (*Pomolobus chrysochloris*).

THE SALMONS, TROUTS, WHITEFISHES, ETC. (SALMONIDÆ):

- Common whitefishes (*Coregonus albus* and *C. clupeaformis*).
- Cisco (chiefly *Leucichthys artedii*).
- Chinook salmon, king salmon, quinnat salmon (*Oncorhynchus tshawytscha*).
- Chum salmon, dog salmon (*Oncorhynchus keta*).
- Humpback salmon, pink salmon (*Oncorhynchus gorbuscha*).
- Silver salmon, coho salmon (*Oncorhynchus kisutch*).
- Sockeye salmon, blueback salmon, redfish (*Oncorhynchus nerka*).
- Steelhead salmon (*Salmo gairdneri*).
- Atlantic salmon (*Salmo salar*).
- Landlocked salmon (*Salmo sebago*).
- Rainbow trout (*Salmo shasta*).
- Blackspotted trout, redthroat trout (*Salmo lewisi*).
- Loch Leven trout (*Salmo levenensis*).
- Lake trout, Mackinaw trout (*Cristivomer namaycush*).
- Brook trout (*Salvelinus fontinalis*).

THE GRAYLINGS (THYMALLIDÆ):

- Montana grayling (*Thymallus montanus*).

THE SMELTS (OSMERIDÆ):

- Smelt (*Osmerus mordax*).

THE PIKES (LUCIDÆ):

- Little pickerel (*Lucius vermiculatus*).
- Common pickerel (*Lucius lucius*).

THE SUNFISHES, BLACK BASSES, AND CRAPPIES (CENTRARCHIDÆ):

- Crapplies (*Pomoxis annularis* and *P. sparoides*).
- Largemouth black bass (*Micropterus salmoides*).
- Smallmouth black bass (*Micropterus dolomieu*).
- Rock bass (*Ambloplites rupestris*).
- Warmouth bass, goggle-eye (*Chenobryttus gulosus*).
- Bluegill sunfish (*Lepomis pallidus*).
- Common sunfish (*Eupomotis gibbosus*).

THE PERCHES (PERCIDÆ):

- Pike perch (*Stizostedion vitreum*).
- Yellow perch (*Perca flavescens*).

THE BASSES (SERRANIDÆ):Striped bass, rockfish (*Roccus lineatus*).White bass (*Roccus chrysops*).White perch (*Morone americana*).**THE DRUMS (SCIAENIDÆ):**Fresh-water drum, lake sheepshead (*Aplodinotus grunniens*).**THE CODS (GADIDÆ):**Cod (*Gadus callarias*).Haddock (*Melanogrammus aeglefinus*).Pollock (*Pollachius virens*).**THE FLOUNDERS (PLEURONECTIDÆ):**Winter flounder, American flatfish (*Pseudopleuronectes americanus*).Pole flounder (*Glyptocephalus cynoglossus*).**SUMMARY OF OUTPUT.**

During the fiscal year 1921 the bureau's efforts in fish propagation and rescue of stranded fishes resulted in a gross output of 4,962,583,555 fish and fish eggs for distribution, 93 per cent of which was made up of the important commercial species and 7 per cent of the species used in stocking interior waters. Losses due to transportation amounted to 94,150, making a net product of fish and fish eggs actually distributed of 4,962,489,405. A summary of this net output, shown by species, is given in the following table:

SUMMARY, BY SPECIES, OF NET OUTPUT OF FISH AND FISH EGGS, FISCAL YEAR 1921.

Species.	Eggs.	Fry.	Fingerlings.	Total.
Catfish.....			35,257,070	35,257,070
Buffalo fish.....		108,307,000	1,645,835	109,952,835
Carp.....		106,043,000	3,918,580	109,961,580
Shad.....		32,792,275		32,792,275
Gilt herring.....		43,815,000		43,815,000
Whitefish.....	181,650,000	238,800,000		420,450,000
Cisco.....	186,510,000	89,800,000		276,310,000
Chinook salmon.....	6,780,000		32,780,765	39,560,765
Coho salmon.....		7,000,000	19,436,400	26,436,400
Silver salmon.....		600,000	6,486,150	7,086,150
Sockeye salmon.....	350,000	38,778,500	30,434,500	69,563,000
Steelhead salmon.....	493,000	38,810	2,928,915	3,460,725
Atlantic salmon.....		1,387,000	280	1,387,280
Landlocked salmon.....	575,000	208,115	124,250	907,365
Rainbow trout.....	2,553,240	414,100	3,872,225	6,839,565
Blackspotted trout.....	820,000	3,899,100	1,000,300	5,719,400
Loch Leven trout.....			64,000	64,000
Lake trout.....	2,824,000	16,463,300	208,500	19,595,800
Brook trout.....	826,890	3,642,330	7,559,625	12,028,845
Grayling.....		1,400,000		1,400,000
Smelt.....	600,000	7,000,000		7,600,000
Pike and pickerel.....			540,510	540,510
Crappie.....			37,303,900	37,303,900
Largemouth black bass.....			1,221,905	1,221,905
Smallmouth black bass.....		303,700	54,500	358,200
Rock bass.....			108,305	108,305
Warmouth bass.....			100	100
Sunfish.....			30,371,475	30,371,475
Pike perch.....	296,475,000	57,385,000	108,515	354,968,515
Yellow perch.....	12,000,000	176,369,450	6,166,435	194,535,885
Striped bass.....		20,184,000		20,184,000
White bass.....			27,170	27,170
Freshwater drum.....			34,080	34,080
Cod.....	208,800,000	175,341,000		384,141,000
Haddock.....	188,940,000	271,880,000		460,820,000
Pollock.....		455,096,000		455,096,000
Winter flounder.....		1,768,680,000		1,768,680,000
Pole flounder.....	19,410,000			19,410,000
Miscellaneous fishes.....			4,935,165	4,935,165
Total.....	1,109,637,130	3,626,202,730	226,589,545	4,962,489,405

SUMMARY OF EGG COLLECTIONS.

Eggs are obtained by several methods, but the principal source of supply is the commercial fisheries, where, were it not for the bureau's

activities, vast numbers of eggs would be sent to market in the fish and become a total loss. In the case of certain species, notably but not exclusively the salmon of the Pacific coast, where commercial fishing does not extend to or is not permitted on the spawning areas, employees of the bureau capture the spawning fish either in seines or in traps and artificially incubate in its hatcheries the eggs thus obtained. The object of this work is to bring about a higher percentage of fertility in the eggs than is possible in natural reproduction and to afford the eggs and the resulting young fish protection from their natural enemies. Eggs in appreciable numbers are also obtained from domesticated fish, which are maintained in ponds at fish-cultural stations from year to year under more or less artificial conditions.

A decrease of approximately 121,000,000 in the aggregate egg collections occurred this season as compared with last year, as is indicated by the accompanying table, and the same causes that were operative to the detriment of the work then were again in evidence. However, in any line of enterprise where results are dependent to a large extent upon weather conditions, as is the case in all of our egg-collecting fields, a comparison of one season's work with that of another will indicate a considerable fluctuation in total results, and it is only by comparing the results over a period of years that the actual trend of the work may be traced with any degree of accuracy.

The most noticeable variations in the egg collections of 1921 as compared with 1920 are increased collections of eggs of chum salmon, cisco, rainbow trout, blackspotted trout, whitefish, pike perch, yellow perch, striped bass, carp, haddock, and glut herring, and decreased collections of eggs of the chinook, silver, sockeye, humpback, and steelhead salmon, landlocked salmon, lake and brook trout, shad, buffalofish, cod, pollock, and other species of less importance. It is to be noted that while a decrease occurred in the number of eggs collected during 1921, as compared with the previous year, there was an increase of approximately 179,000,000 in the aggregate output of the stations in eggs, fry, and fingerlings. This apparent discrepancy in figures is accounted for by the better quality of the eggs handled during the year and the higher percentage of fry produced: also to an increase in the numbers of eggs fertilized and planted on the spawning grounds.

COMPARISON OF EGG COLLECTIONS, 1920 AND 1921.

Species.	Fiscal year 1920	Fiscal year 1921.	Species.	Fiscal year 1920.	Fiscal year 1921.
Buffalo fish.....	236,400,000	163,267,000	Blackspotted trout..	2,617,600	5,993,600
Carp.....	47,250,000	117,218,000	Loch Leven trout....	85,000	94,200
Shad.....	65,667,000	37,549,000	Lake trout.....	53,753,000	44,247,500
Glut herring.....		55,130,000	Brook trout.....	19,947,900	16,110,800
Alewife.....	130,000		Grayling.....	700,000	
Whitefish.....	422,789,000	540,776,000	Smelt.....		8,000,000
Cisco.....	181,150,000	317,200,000	Pike perch.....	416,100,000	508,942,000
Chinook salmon.....	51,793,000	43,829,820	Yellow perch.....	175,398,000	218,333,750
Chum salmon.....	13,417,000	28,182,000	Striped bass.....	19,358,000	24,600,000
Humpback salmon.....	579,300		Cod.....	912,417,000	482,012,000
Silver salmon.....	10,079,000	8,273,000	Haddock.....	406,235,000	635,950,000
Sockeye salmon.....	108,115,000	76,012,500	Pollock.....	954,800,000	650,850,000
Steelhead salmon.....	4,006,609	1,603,000	Winter flounder.....	1,805,167,000	1,980,291,000
Atlantic salmon.....	797,600	911,720	Pole flounder.....		19,410,000
Landlocked salmon.....	2,026,800	1,063,200			
Rainbow trout.....	9,631,200	10,904,750	Total.....	6,121,390,000	5,996,844,870

SUMMARY OF FISH-RESCUE WORK.

That part of the net output for the fiscal year 1921 derived from the rescue of stranded fishes is shown in the following table, which gives for each point from which the rescue work was conducted the total number of each species salvaged, the portion of that total restored to the original waters and the portion delivered to applicants; and for each species the total number rescued, the portion of that total restored to the original waters, and the portion delivered to applicants.

For a discussion of the rescue operations and suggestions for the enlargement of their scope, see page 78.

NUMBER AND DISPOSITION OF FISH RESCUED FROM OVERFLOWED LANDS, FISCAL YEAR 1921.

Station.	Species.	Delivered to applicants.	Restored to original waters.	Total.
Bellevue, Iowa.....	Buffalofish.....	150	313,865	314,015
	Carp.....	434	132,325	132,759
	Catfish.....	64,390	2,147,350	2,211,740
	Crappie.....	7,565	4,789,935	4,797,500
	Drum.....	.....	2,295	2,295
	Largemouth black bass.....	30,510	27,400	57,910
	Pike and pickerel.....	410	19,185	19,595
	Pike perch.....	.....	250	250
	Sunfish.....	35,120	3,595,630	3,630,750
	White bass.....	175	9,410	9,585
	Yellow perch.....	5,900	5,100	11,000
	Miscellaneous.....	.....	2,698,600	2,698,600
Total.....		144,654	13,738,345	13,882,999
Cairo, Ill.....	Buffalofish.....	.....	107,350	107,350
	Carp.....	.....	44,715	44,715
	Catfish.....	.....	670,800	670,800
	Crappie.....	.....	170,800	170,800
	Largemouth black bass.....	.....	2,600	2,600
	Pike and pickerel.....	.....	4,900	4,900
	Sunfish.....	.....	55,250	55,250
Total.....	White bass.....	.....	800	800
			1,057,215	1,057,215
Fairport (Iowa) and auxiliaries.	Buffalofish.....	.....	104,473	104,473
	Carp.....	.....	53,757	53,757
	Catfish.....	.....	1,013,826	1,013,826
	Crappie.....	4,000	166,827	170,827
	Drum.....	.....	420	420
	Largemouth black bass.....	1,450	4,838	6,288
	Pike and pickerel.....	150	321	471
	Sunfish.....	8,300	71,711	80,011
	White bass.....	.....	3,176	3,176
	Miscellaneous.....	.....	5,872	5,872
Total.....		13,900	1,425,221	1,439,121
Homer, Minn.....	Buffalofish.....	.....	30,165	30,165
	Carp.....	57	1,190,303	1,190,360
	Catfish.....	42,178	10,727,650	10,769,828
	Crappie.....	39,835	15,919,625	15,959,460
	Drum.....	.....	19,405	19,405
	Largemouth black bass.....	30,770	139,045	169,815
	Pike and pickerel.....	.....	175,040	175,040
	Pike perch.....	.....	108,265	108,265
	Sunfish.....	39,135	11,716,580	11,755,715
	White bass.....	.....	6,990	6,990
	Yellow perch.....	12,635	4,980,187	4,992,822
	Miscellaneous.....	.....	527,080	527,080
Total.....		164,610	45,540,335	45,704,945

NUMBER AND DISPOSITION OF FISH RESCUED FROM OVERFLOWED LANDS, ETC.—CON.

Station.	Species.	Delivered to applicants.	Restored to original waters.	Total.
La Crosse, Wis.....	Buffalofish.....	1,020	799,510	800,530
	Carp.....	25	2,059,164	2,059,189
	Catfish.....	33,300	18,560,800	18,594,100
	Crappie.....	16,625	14,455,540	14,472,165
	Drum.....		11,960	11,960
	Largemouth black bass.....	132,180	103,985	236,165
	Pike and pickerel.....		322,130	322,130
	Sunfish.....	15,050	12,678,660	12,693,710
	White bass.....		6,620	6,620
	Yellow perch.....	1,805	1,011,000	1,012,805
	Miscellaneous.....		904,110	904,110
Total.....		200,005	50,913,479	51,113,484
Marquette, Iowa.....	Buffalofish.....		243,000	243,000
	Carp.....	85	340,515	340,600
	Catfish.....	19,650	1,098,350	1,118,000
	Crappie.....	5,650	1,620,250	1,625,900
	Largemouth black bass.....	33,940	5,990	39,930
	Pike and pickerel.....		18,375	18,375
	Rock bass.....	75		75
	Sunfish.....	11,800	1,627,100	1,638,900
	Yellow perch.....	5,800	211,625	217,425
	Miscellaneous.....		788,500	788,500
Total.....		77,000	5,953,705	6,030,705
Quincy, Ill.....	Buffalofish.....		46,300	46,300
	Carp.....		91,200	91,200
	Catfish.....	14,975	785,200	800,175
	Crappie.....	400	92,900	93,300
	Largemouth black bass.....	35,790	1,800	37,590
	Sunfish.....	5,740	139,560	145,300
	Yellow perch.....	150	50	200
	Miscellaneous.....		11,000	11,000
Total.....		57,055	1,168,010	1,225,065
San Marcos, Tex.....	Catfish.....		70,000	70,000
	Largemouth black bass.....	2,886	60,000	62,886
	Sunfish.....		70,000	70,000
Total.....		2,886	200,000	202,886
Total of all stations.....	Buffalofish.....	1,170	1,644,663	1,645,833
	Carp.....	601	3,917,979	3,918,580
	Catfish.....	174,493	35,073,976	35,248,469
	Crappie.....	74,075	37,206,877	37,280,952
	Drum.....		34,080	34,080
	Largemouth black bass.....	267,526	345,658	613,184
	Pike and pickerel.....	560	539,951	540,511
	Pike perch.....		108,515	108,515
	Rock bass.....	75		75
	Sunfish.....	115,145	29,954,491	30,069,636
	White bass.....	175	26,996	27,171
	Yellow perch.....	26,290	6,207,962	6,234,252
	Miscellaneous.....		4,935,162	4,935,162
Grand total.....		660,110	119,996,310	120,656,420

STATIONS AND SUBSTATIONS OPERATED AND OUTPUT OF EACH.

During the fiscal year 1921 fish-cultural work was conducted from 37 main stations, 32 substations, and approximately 60 egg-collecting or auxiliary stations. The following table gives the main fish-cultural stations, in alphabetical order, and the substations operative during the year, the period of operation of each, and the number of fish and eggs, by species, furnished for distribution by each station through propagation, through collections from auxiliary stations, and through rescue of fish from overflowed lands of the Mississippi Basin. It will be noted that transfers of fish and eggs from station to station are frequent. (For table of egg transfers, see p. 15.) Such transfers are made in the interest of economy and convenience

where the shipments consist of eggs and give advantageous distribution centers in the case of young fish.

STATIONS AND SUBSTATIONS OPERATED, AND OUTPUT OF EACH, FISCAL YEAR 1921.

[Asterisk (*) denotes transfer of eggs. See table, p. 15.]

Station and period of operation.	Species.	Eggs.	Fry.	Fingerlings, yearlings, and adults.	Total.
Adognak, Alaska:*					
Entire year.....	Sockeye salmon.....	(*)	30,211,000	17,597,000	47,808,000
Baird, Calif.:					
Entire year.....	Chinook salmon.....			1,465,000	1,465,000
Battle Creek, Calif.:					
Entire year.....	do.....	(*)		1,781,000	1,781,000
Mill Creek, Calif.:					
Entire year.....	do.....	3,000,000		1,347,400	4,347,400
Baker Lake, Wash.:					
Entire year.....	Sockeye salmon.....		7,050,000		7,050,000
Birdsview, Wash.:					
Entire year.....	Blackspotted trout.....		23,700		23,700
	Chinook salmon.....			973,865	973,865
	Chum salmon.....			1,536,000	1,536,000
	Silver salmon.....		600,000	2,176,000	2,776,000
	Sockeye salmon.....	(*)		9,000	9,000
	Steelhead salmon.....	* 85,000		128,250	213,250
Brinnon, Wash.:					
November-June.....	Chum salmon.....		1,500,000	575,000	2,075,000
	Steelhead salmon.....	100,000			100,000
Duckabush, Wash.:					
Entire year.....	Chum salmon.....		5,500,000	5,682,000	11,182,000
	Silver salmon.....			50,000	50,000
	Steelhead salmon.....			1,095,000	1,095,000
Quilcene, Wash.:					
Entire year.....	Chum salmon.....			6,575,500	6,575,500
	Silver salmon.....			470,800	470,800
	Steelhead salmon.....	85,000		303,500	388,500
Quinault, Wash.:					
Entire year.....	Chinook salmon.....			24,800	24,800
	Silver salmon.....			1,398,000	1,398,000
	Sockeye salmon.....		950,000	3,448,000	4,398,000
Sultan, Wash.:					
Entire year.....	Chinook salmon.....			303,300	303,300
	Silver salmon.....			1,974,300	1,974,300
	Steelhead salmon.....			76,800	76,800
Berkshire, Mass.:					
Entire year.....	Brook trout.....			296,825	296,825
Boothbay Harbor, Me.:					
Entire year.....	Rainbow trout.....			41,900	41,900
Boseman, Mont.:					
Entire year.....	Flounder.....		841,235,000		841,235,000
	Pollock.....		11,906,000		11,906,000
Glacier Park, Mont.:					
March-June.....	Blackspotted trout.....			420,000	420,000
	Brook trout.....			30,000	30,000
	Grayling.....		1,400,000		1,400,000
	Rainbow trout.....			185,000	185,000
Yellowstone, Wyo.:					
July-September.....	Blackspotted trout.....	* 820,000	2,012,400		2,832,400
Cape Vincent, N. Y.:					
Entire year.....	Brook trout.....		397,000		397,000
	Cisco.....	* 186,510,000	89,400,000		275,910,000
	Lake trout.....	30,000	450,000		480,000
	Pike perch.....		7,970,000		7,970,000
	Rainbow trout.....		66,100		66,100
	Whitefish.....	* 89,650,000	40,300,000		129,950,000
	Yellow perch.....		11,000,000	2,150	11,002,150
Central Station, Wash- ington, D. C.:					
Entire year.....	Brook trout.....			36,200	36,200
	Chinook salmon.....			12,500	12,500
	Cisco.....		400,000		400,000
	Pike perch.....		1,500,000		1,500,000
	Rainbow trout.....			20,400	20,400
	Shad.....		800,000		800,000
	Whitefish.....		800,000		800,000
	Yellow perch.....		500,000		500,000
Bryans Point, Md.:					
February-May.....	Shad.....		13,639,175		13,639,175
	Yellow perch.....		158,819,450		158,819,450

* Fry produced at Meadow Creek auxiliary station.

STATIONS AND SUBSTATIONS OPERATED, AND OUTPUT OF EACH, FISCAL YEAR 1921—Continued.

[Asterisk (*) denotes transfer of eggs. See table, p. 15.]

Station and period of operation.	Species.	Eggs.	Fry.	Fingerlings, yearlings, and adults.	Total.
Clackamas, Oreg.: Entire year.....	Blackspotted trout.....			95,000	95,000
	Brook trout.....			4,000	4,000
	Chinook salmon.....	130,000		4,362,000	4,492,000
Applegate, Oreg.— Entire year.....	do.....			77,400	77,400
	Silver salmon.....			35,150	35,150
	Steelhead salmon.....			450,000	450,000
Big White Salmon, Wash.— Entire year.....	Chinook salmon.....			4,000,000	4,000,000
Little White Salmon, Wash.— Entire year.....	do.....	950,000		12,190,000	13,140,000
	Chum salmon.....			5,067,900	5,067,900
Rogue River, Oreg.— Entire year.....	Blackspotted trout.....			47,500	47,500
	Chinook salmon.....			4,308,000	4,308,000
	Rainbow trout.....			189,500	189,500
	Silver salmon.....			381,900	381,900
	Steelhead salmon.....			866,000	866,000
Salmon, Idaho— July–September.....	Chinook salmon.....	2,700,000			2,700,000
Upper Clackamas, Oreg.— Entire year.....	do.....			1,935,500	1,935,500
Washougal, Wash.— April–June.....	Steelhead salmon.....	223,000	15,000		238,000
Willamette, Oreg.— July–June.....	Shad.....		2,347,100		2,347,100
Cold Springs, Ga.: Entire year.....	Catfish.....			4,120	4,120
	Crappie.....			1,550	1,550
	Largemouth black bass.....		144,750	67,805	212,555
	Sunfish.....			61,350	61,350
	Warmouth bass.....			100	100
Craig Brook, Me.: Entire year.....	Atlantic salmon.....		1,387,000	280	1,387,280
	Brook trout.....		1,085,000	23,625	1,108,625
	Landlocked salmon.....		8,395	35,150	43,545
	Sockeye salmon.....		17,500		17,500
Duluth, Minn.: * Entire year.....	Brook trout.....			110,000	110,000
	Lake trout.....	* 100,000	6,057,000	147,500	6,304,500
	Pike perch.....		8,500,000		8,500,000
	Rainbow trout.....			20,500	20,500
	Whitefish.....		9,600,000		9,600,000
Edenton, N. C.: Entire year.....	Glut herring.....		43,815,000		43,815,000
	Largemouth black bass.....			23,085	23,085
	Shad.....		16,006,000		16,006,000
	Sunfish.....			9,905	9,905
Weldon, N. C.— April–May.....	Striped bass.....		20,184,000		20,184,000
Erwin, Tenn.: Entire year.....	Brook trout.....			300,435	300,435
	Crappie.....			400	400
	Largemouth black bass.....		33,000	32,980	65,980
	Rainbow trout.....	55,000		700,100	755,100
	Rock bass.....			17,200	17,200
	Smallmouth black bass.....			5,165	5,165
	Sunfish.....			20,350	20,350
Fairport, Iowa, and sub- stations: Entire year.....	Buffalofish.....			104,473	104,473
	Carp.....			53,757	53,757
	Catfish.....			1,013,826	1,013,826
	Crappie.....			170,827	170,827
	Drum.....			420	420
	Largemouth black bass.....			6,288	6,288
	Pike and pickerel.....			471	471
	Sunfish.....			80,011	80,011
	White bass.....			3,176	3,176
	Miscellaneous.....			5,872	5,872

STATIONS AND SUBSTATIONS OPERATED, AND OUTPUT OF EACH, FISCAL YEAR
1921—Continued.

(Asterisk (*) denotes transfer of eggs. See table, p. 15.)

Station and period of operation.	Species.	Eggs.	Fry.	Fingerlings, yearlings, and adults.	Total.
Gloucester, Mass.: *					
Entire year.....	Cod.....	208,800,000	50,900,000		259,700,000
	Flounder (pole).....	19,410,000			19,410,000
	Flounder (winter).....		132,070,000		132,070,000
	Haddock.....	188,940,000	271,880,000		460,820,000
	Pollock.....	(*)	443,160,000		443,160,000
Green Lake, Me.:					
Entire year.....	Brook trout.....		608,050		608,050
	Landlocked salmon.....	495,000	144,720		639,720
	Rainbow trout.....		26,000		26,000
	Smelt.....	600,000	7,000,000		7,600,000
Grand Lake Stream, Me.*—					
Entire year.....	Brook trout.....		47,880		47,880
	Landlocked salmon.....	* 80,000	55,000	79,100	214,100
Homer, Minn.:					
Entire year.....	Buffalofish.....			30,165	30,165
	Carp.....			1,190,360	1,190,360
	Catfish.....			10,769,828	10,769,828
	Crappie.....			15,959,460	15,959,460
	Drum.....			19,405	19,405
	Largemouth black bass.....			169,815	169,815
	Pike and pickerel.....			175,040	175,040
	Pike perch.....			108,265	108,265
	Rock bass.....			3,300	3,300
	Sunfish.....			11,755,715	11,755,715
	White bass.....			6,990	6,990
	Yellow perch.....			4,992,822	4,992,822
	Miscellaneous.....			527,080	527,080
Atchafalaya, La.—					
February-April.....	Buffalofish.....		40,040,000		40,040,000
Bellevue, Iowa—					
July-November.....	Buffalofish.....		68,267,000	314,015	68,581,015
	Carp.....		42,718,000	138,759	42,856,759
	Catfish.....			2,211,740	2,211,740
	Crappie.....			4,788,500	4,788,500
	Drum.....			2,295	2,295
	Largemouth black bass.....			57,910	57,910
	Pike and pickerel.....			19,595	19,595
	Pike perch.....			250	250
	Sunfish.....			3,630,750	3,630,750
	White bass.....			9,585	9,585
	Yellow perch.....			11,000	11,000
	Miscellaneous.....			2,698,605	2,698,605
La Crosse, Wis.—					
Entire year.....	Brook trout.....		107,000	316,050	423,050
	Buffalofish.....			800,530	800,530
	Carp.....			2,059,189	2,059,189
	Catfish.....			18,594,100	18,594,100
	Crappie.....			14,472,165	14,472,165
	Drum.....			11,960	11,960
	Largemouth black bass.....			236,165	236,165
	Pike and pickerel.....			322,130	322,130
	Rainbow trout.....			53,690	53,690
	Sunfish.....		30,000	12,693,710	12,693,710
	White bass.....			6,620	6,620
	Yellow perch.....			1,012,805	1,012,805
	Miscellaneous.....			904,110	904,110
Marquette, Iowa—July-					
November.....	Buffalofish.....			243,000	243,000
	Carp.....			340,600	340,600
	Catfish.....			1,118,000	1,118,000
	Crappie.....			1,625,900	1,625,900
	Largemouth black bass.....			39,930	39,930
	Pike and pickerel.....			18,375	18,375
	Rock bass.....			75	75
	Sunfish.....			1,638,900	1,638,900
	Yellow perch.....			217,425	217,425
	Miscellaneous.....			788,500	788,500
Meredosia, Ill.—					
July-November.....	Buffalofish.....			46,300	46,300
	Carp.....			91,200	91,200
	Catfish.....			800,175	800,175
	Crappie.....			93,300	93,300
	Largemouth black bass.....			37,590	37,590
	Sunfish.....			145,300	145,300
	Yellow perch.....			209	209
	Miscellaneous.....			11,060	11,060

* Represents eggs fertilized and planted on spawning grounds.

STATIONS AND SUBSTATIONS OPERATED, AND OUTPUT OF EACH, FISCAL YEAR 1921—Continued.

[Asterisk (*) denotes transfer of eggs. See table, p. 15.]

Station and period of operation.	Species.	Eggs.	Fry.	Fingerlings, yearlings, and adults.	Total.
Leadville, Colo.* Entire year.....	Blackspotted trout.....		950,500		950,500
	Brook trout.....	*500,000		2,705,000	3,205,000
	Lake trout.....			24,000	24,000
	Loch Leven trout.....			34,000	34,000
	Rainbow trout.....			99,500	99,500
Louisville, Ky.: Entire year.....	Largemouth black bass.....		32,000	1,100	33,100
	Rock bass.....			4,500	4,500
	Smallmouth black bass.....		146,000	10,700	156,700
	Sunfish.....			76,150	76,150
	Yellow perch.....		750,000		750,000
Cairo, Ill.— July-October.....	Buffalofish.....			107,350	107,350
	Carp.....			44,715	44,715
	Catfish.....			670,800	670,800
	Crappie.....			170,800	170,800
	Largemouth black bass.....			2,600	2,600
	Pike and pickerel.....			4,900	4,900
	Sunfish.....			55,250	55,250
	White bass.....			800	800
Mammoth Spring, Ark.: Entire year.....	Largemouth black bass.....			1,400	1,400
	Rock bass.....			4,725	4,725
	Smallmouth black bass.....		24,000	2,200	26,200
Manchester, Iowa.* Entire year.....	Brook trout.....			466,225	466,225
	Rainbow trout.....	*65,500		155,950	221,450
	Rock bass.....			53,910	53,910
	Smallmouth black bass.....			2,500	2,500
Nashua, N. H.: Entire year.....	Brook trout.....			785,600	785,600
	Pike perch.....		1,175,000		1,175,000
	Rainbow trout.....			42,000	42,000
	Smallmouth black bass.....		31,700		31,700
Neosho, Mo.* Entire year.....	Catfish.....			3,000	3,000
	Crappie.....			13,222	13,222
	Largemouth black bass.....			20,175	20,175
	Rainbow trout.....			167,965	167,965
	Rock bass.....	*100,000		10,040	10,040
	Smallmouth black bass.....		1,500	2,701	4,201
	Sunfish.....			31,680	31,680
	Yellow perch.....			58	58
Northville, Mich.: Entire year.....	Brook trout.....		321,000	146,225	467,225
	Rainbow trout.....		42,000	51,575	93,575
	Smallmouth black bass.....			31,200	31,200
Bay City, Mich.— April-May.....	Pike perch.....	277,250,000	7,040,000		284,290,000
Charlevoix, Mich.*— Entire year.....	Lake trout.....	*2,685,000	10,000,000		12,685,000
	Steelhead salmon.....		23,810		23,810
	Whitefish.....	15,000,000	20,000,000		35,000,000
Orangeburg, S. C.: Entire year.....	Crappie.....			300	300
	Largemouth black bass.....			204,675	204,675
	Rock bass.....			500	500
	Sunfish.....			14,200	14,200
Put in Bay, Ohio.* Entire year.....	Carp.....		63,325,000		63,325,000
	Pike perch.....		12,600,000		12,600,000
	Whitefish.....	*77,000,000	167,500,000		244,500,000
St. Johnsbury, Vt.: Entire year.....	Brook trout.....	256,800	931,900	85,800	1,274,500
	Lake trout.....		37,000		37,000
	Landlocked salmon.....			10,000	10,000
	Steelhead salmon.....			5,875	5,875
Holden, Vt.— Entire year.....	Brook trout.....		144,500	29,200	173,700
	Lake trout.....		19,300	12,350	31,650
	Rainbow trout.....			400	400
	Steelhead salmon.....			3,490	3,490
Swanton, Vt.*— March-May.....	Pike perch.....	*19,225,000	18,100,000		37,325,000
	Yellow perch.....	12,000,000	5,300,000		17,300,000

STATIONS AND SUBSTATIONS OPERATED, AND OUTPUT OF EACH, FISCAL YEAR 1921—Continued.

[Asterisk (*) denotes transfer of eggs. See table, p.15.]

Station and period of operation.	Species.	Eggs.	Fry.	Fingerlings, yearlings, and adults.	Total.
San Marcos, Tex.: Entire year.....	Black bass.....			257, 715	257, 715
	Catfish.....			70, 000	70, 000
	Crappie.....			5, 904	5, 904
	Rock bass.....			320	320
	Sunfish.....			74, 872	74, 872
Saratoga, Wyo.:* Entire year.....	Blackspotted trout.....			194, 000	194, 000
	Brook trout.....	100, 000		129, 000	229, 000
	Rainbow trout.....	* 1, 297, 740		145, 000	1, 442, 740
Spearsfish, S. Dak.: Entire year.....	Brook trout.....			530, 000	530, 000
	Lake trout.....			29, 900	29, 900
	Loch Leven trout.....			34, 000	34, 000
	Rainbow trout.....			126, 945	126, 945
Springville, Utah:* Entire year.....	Blackspotted trout.....			91, 300	91, 300
	Brook trout.....	(*)		200, 300	200, 300
	Catfish.....			2, 000	2, 000
	Rainbow trout.....	* 350, 000		172, 000	522, 000
Paris, Idaho— March-April.....	Whitefish.....		600, 000		600, 000
Tupelo, Miss.: Entire year.....	Crappie.....			1, 280	1, 280
	Largemouth black bass.....		351, 000	54, 500	405, 500
	Sunfish.....			73, 005	73, 005
White Sulphur Springs, W. Va.:* Entire year.....	Brook trout.....			857, 400	857, 400
	Crappie.....			550	550
	Largemouth black bass.....		25, 800	600	26, 400
	Rainbow trout.....	* 250, 000		663, 151	913, 151
	Rock bass.....			175	175
	Smallmouth black bass.....		100, 500	125	100, 625
Woods Hole, Mass.:* Entire year.....	Cod.....	(*)	124, 441, 000		124, 441, 000
	Flounder.....		795, 355, 000		795, 355, 000
Wytheville, Va.:* Entire year.....	Brook trout.....			40, 900	40, 900
	Crappie.....			160	160
	Largemouth black bass.....			9, 423	9, 423
	Pike perch.....		500, 000		500, 000
	Rainbow trout.....	* 110, 000		315, 550	425, 550
	Rock bass.....			14, 060	14, 060
	Smallmouth black bass.....			100	100
	Sunfish.....			10, 325	10, 325
Yes Bay, Alaska: Entire year.....	Sockeye salmon.....	350, 000	550, 000	9, 380, 500	10, 280, 500
Gross output.....		1, 109, 637, 130	3, 626, 262, 230	226, 682, 195	4, 962, 583, 555
Loss in transit.....			1, 500	92, 650	94, 150
Net output.....		1, 109, 637, 130	3, 626, 262, 730	226, 589, 545	4, 962, 489, 405

EGG-COLLECTING OR AUXILIARY STATIONS.

The eggs hatched at the main stations and substations listed in the foregoing table are in many cases obtained from auxiliary sources, usually temporary stations occupied during the season only or, in some instances, mere camps, which are shifted from year to year. In the Great Lakes and off the New England coast collections are made by the bureau's vessels or boats in favorable localities. The following stations and egg-collecting points, operative for the periods indicated, furnished eggs of the given species for the main hatcheries during 1921.

EGG-COLLECTING STATIONS AND SPECIES HANDLED, FISCAL YEAR 1921.

Stations.	Period of operation.	Species handled.
Bozeman, Mont.:		
Meadow Creek, Mont.	April to June.	Rainbow trout.
Yellowstone Park, Wyo.	July to September	Blackspotted trout.
Clear Creek.	do.	Do.
Columbine Creek.	do.	Do.
Cub Creek.	do.	Do.
Thumb Creek.	do.	Do.
Cape Vincent, N. Y.:		
Bygotts Point, N. Y.	November	Cisco, whitefish.
Chaumont Bay, N. Y.	November and December.	Do.
Deseronte, Canada.	do.	Do.
Fair Haven Bay, N. Y.	do.	Do.
Grass Bay, N. Y.	May.	Yellow perch.
Pigeon Island, Canada.	October and November.	Lake trout.
Sodus Bay, N. Y.	November and December.	Cisco.
South Bay, Canada.	do.	Whitefish.
Stony Island, N. Y.	October and November.	Lake trout.
Duluth, Minn.:		
Boy River, Minn.	April.	Pike perch.
Bricsburg, Minn.	do.	Do.
Grand Marais, Mich.	October and November.	Lake trout.
Keystone, Mich.	do.	Do.
Lac La Belle, Mich.	do.	Do.
Manitou Island, Mich.	do.	Do.
Marquette, Mich.	do.	Do.
Munising, Mich.	do.	Do.
Ontonagon, Mich.	do.	Do.
Portage, Mich.	do.	Do.
Washington Harbor, Mich.	do.	Do.
Green Lake, Me.: Fish River Lake, Me.	November	Landlocked salmon.
Leadville, Colo.:		
Carroll Lake, Colo.	October and November.	Brook trout.
Crystal Lake, Colo.	do.	Do.
Engelbrecht Lake, Colo.	do.	Do.
Evergreen Lake, Colo.	do.	Do.
Hen and Ford Lakes, Colo.	do.	Do.
Musgrove Lake, Colo.	do.	Do.
Northfield, Colo.	do.	Do.
Turquoise Lake, Colo.	do.	Brook and Loch Leven trout.
Northville, Mich.:		
Alpena, Mich.	November	Lake trout, white fish.
Cheboygan, Mich.	do.	Do.
Detour, Mich.	do.	Do.
Frankfort, Mich.	do.	Do.
Leland, Mich.	do.	Do.
Manistique, Mich.	do.	Do.
Northport, Mich.	do.	Do.
St. Ignace, Mich.	do.	Do.
St. James, Mich.	do.	Do.
St. Joseph, Mich.	do.	Do.
Scotts Point, Mich.	do.	Whitefish.
Put in Bay, Ohio:		
Catawba Island, Ohio.	November and December.	Do.
Isle St. George, Ohio.	do.	Do.
Port Clinton, Ohio.	November and December, April to June.	Whitefish, carp, pike perch.
Toledo, Ohio.	November and December, April.	Whitefish, pike, perch.
St. Johnsbury, Vt.:		
Darling Pond, Vt.	September to December.	Brook trout.
Lake Mitchell, Vt.	September to November.	Do.
Margalloway River, Me.	do.	Do.
Saratoga, Wyo.:		
Canon Creek, Wyo.	April to June.	Rainbow trout.
Lost Creek, Wyo.	do.	Do.
Sage Creek, Wyo.	do.	Do.
Spearsfish, S. Dak.:		
Crow Creek, S. Dak.	October to December.	Brook and Loch Leven trout.
Schmid Ponds, S. Dak.	do.	Do.
Springville, Utah: Fish Lake, Utah.	October and November, April and May.	Brook and rainbow trout.
Woods Hole, Mass.:		
Quisset, Mass.	February and March.	Winter flounder.
Waquolt, Mass.	do.	Do.
Wickford, R. I.	March.	Do.

TRANSFERS OF EGGS.

For the convenient reference of persons interested in the results of the frequent interchange of fish eggs between the various stations of the bureau this table is prepared, indicating all such transfers of eggs during the fiscal year 1921. It is the intention to include a similar table in all future reports.

TRANSFERS OF EGGS, FISCAL YEAR 1921.

Species.	Number of eggs.	From—	To—	Final disposition of fry or fingerlings.
Blackspotted trout. ²	50,000	Yellowstone Park.	Birdsview, Wash...	Washington waters.
	25,000	do.....	Clackamas, Oreg....	Oregon waters.
	1,000,000	do.....	Leadville, Colo.....	Colorado waters.
	200,000	do.....	Saratoga, Wyo.....	Wyoming waters.
Brook trout ² ...	800,000	Leadville, Colo....	Bozeman, Mont.....	Two Medicine Lake and Grinnel Creek, Glacier Park, and other Montana waters.
	350,000	Springville, Utah.	do.....	Do.
	200,000	do.....	Clackamas, Oreg....	Oregon waters.
	452,800	do.....	Saratoga, Wyo.....	Wyoming waters.
	200,000	do.....	Spearfish, S. Dak...	South Dakota waters.
Chinook salmon	¹ 20,000	Battle Creek, Calif.	Central station, Washington, D. C.	Pennsylvania waters.
Cisco.....	1,000,000	Cape Vincent, N. Y.	do.....	Cayuga Lake, N. Y.
Cod.....	8,700,000	Woods Hole, Mass.	Gloucester, Mass....	Atlantic Ocean.
Lake trout.....	25,000	Charlevoix, Mich..	Leadville, Colo.....	Twin Lakes, Colo.
	25,000	do.....	St. Johnsbury, Vt....	Averill Lakes and Lowell Lake, Vt.; Silver Lake, Taylors Pond, and Winnepesaukee Lake, N. H.
	25,000	Duluth, Minn.....	Spearfish, S. Dak...	Reclamation Reservoir, S. Dak.; Big Wind River, Wyo.
Landlocked salmon. ²	10,000	Grand Lake Stream, Me.	Craig Brook, Me.....	Pleasant Lake and Toddy Pond, Me.
	25,000	do.....	St. Johnsbury, Vt....	Lake St. Catherine, Vt.; Lake George, N. Y.
Pike perch.....	8,000,000	Swanton, Vt.....	Cape Vincent, N. Y.	Lake Ontario, N. Y.
	2,025,000	do.....	Central station, Washington, D. C.	Perkiomen Creek, Lake Sheridan, Paupack River, and other Pennsylvania waters.
	2,000,000	do.....	Nashua, N. H.....	Merrimack River and tributaries, N. H.
	500,000	do.....	Wytheville, Va.....	New River, Va.
Pollock.....	24,350,000	Gloucester, Mass..	Boothbay Harbor, Me.	Boothbay Harbor, Me.
Rainbow trout.	² 50,000	Bozeman; Meadow Creek, Mont.	Duluth, Minn.....	Clearwater River, tributary of, Minn.
	² 25,000	do.....	Manchester, Iowa...	Reserved for brood stock.
	² 50,000	do.....	Spearfish, S. Dak...	Spearfish Creek and tributaries, S. Dak.
	² 60,000	Manchester, Iowa.	La Crosse, Wis.....	Spring Valley Creek and tributaries, and other Wisconsin waters.
	² 98,991	Neosho, Mo.....	Erwin, Tenn.....	Pigeon River and North Indian Creek, Tenn.
	² 105,000	Saratoga; Sage Creek, Wyo.	Leadville, Colo.....	Platte River, Rifle Creek, and other Colorado waters.
	² 100,000	Springville; Fish Lake, Utah.	Clackamas, Oreg....	Alder Creek and Clackamas and Molalla Rivers, Oreg.
	² 50,000	do.....	Duluth, Minn.....	French and Sucker Rivers, Minn.
	² 25,000	do.....	Leadville, Colo.....	Platte River, Rifle Creek, and other Colorado waters.
	² 100,000	do.....	Spearfish, S. Dak...	Bear Butte, Horse, and Castle Creeks, S. Dak.
	² 50,000	White Sulphur Springs, W. Va.	Berkshire; Harts-ville, Mass.	Housatonic and Westfield Rivers, Mass.
	² 25,000	do.....	Central station, Washington, D. C.	Potomac and Beaverdam Rivers, Md.
	² 57,000	do.....	Northville, Mich....	Au Sable and Pere Marquette Rivers, Mich.
	² 50,000	do.....	St. Johnsbury, Vt....	Crescent Pond, N. Y.
	² 150,000	Wytheville, Va....	Cape Vincent, N. Y.	Horseshoe Pond, Salmon Creek, and Neversink River, N. Y.
	² 20,000	do.....	Central station, Washington, D. C.	Potomac and Beaverdam Rivers, Md.
	² 50,000	do.....	Green Lake, Me.....	Great Brook and Beaver Pond, Me.
	² 50,000	do.....	Nashua, N. H.....	Cold and Nashua Rivers, N. H.
	² 100,000	White Sulphur Springs, W. Va.	do.....	Cheat and Cranberry Rivers and tributaries and other West Virginia waters.

TRANSFERS OF EGGS, FISCAL YEAR 1921—Continued.

Species.	Number of eggs.	From—	To—	Final disposition of fry or fingerlings.
Sockeye salmon	3,000,000	Afognak, Alaska..	Quinault, Wash.....	Quinault Lake, Wash.
	5,000,000	do.....	Yes Bay, Alaska.....	McDonald Lake, Alaska.
	30,000	Birdsview, Wash..	Clackamas, Oreg.....	Columbia River, Oreg.
Steelhead salmon. ¹	20,000	do.....	Craig Brook, Me.....	Pleasant River, Me.
	25,000	do.....	Charlevoix, Mich.....	Hortons Creek, Mich.
	10,000	do.....	Erwin, Tenn.....	Reserved for brood stock.
	25,500	do.....	Manchester, Iowa.....	Do.
	58,000	do.....	St. Johnsbury, Vt....	Lake Tarleton, N. H.; Cayuga Lake, N. Y.; and Peacham Pond, Vt.
Whitefish.....	750,000	Cape Vincent, N. Y.	Central station, Washington, D. C.	Cayuga Lake, N. Y.
	750,000	Put in Bay, Ohio.	do.....	Do.
	59,120,000	do.....	Charlevoix, Mich.....	Lake Michigan.
	10,000,000	do.....	Duluth, Minn.....	Lake Superior.

¹ For exhibit—fingerlings delivered to Pennsylvania Fish and Game Commission.

² Eggs from wild stock.

³ Eggs from domesticated stock.

⁴ This transfer was due to a misunderstanding of orders.

Propagation of Commercial Fishes.

The more important commercial fishes propagated by the bureau are the salmons of the Pacific coast, the whitefish, cisco (lake herring), lake trout, pike perch, and yellow perch of the Great Lakes, the yellow perch of the Potomac, the carp in the Portage River section of Ohio, the marine species—including the cod, haddock, pollock, winter and pole flounders—the buffalofish in Louisiana, and the anadromous fishes of the Atlantic coast—the shad, glut herring, alewife, striped bass, and Atlantic salmon. A discussion of the propagation of these fishes at the various stations during the fiscal year 1921 follows. Data concerning the spawning seasons for the species at the different stations are assembled in the table on page 72, and the amount and cost of fish food used at the Pacific salmon stations are given in the table on page 75.

PACIFIC SALMON CULTURE.

With the recent increase in the cost of all labor and materials the bureau has found it impossible to maintain the former magnitude of its Pacific salmon operations or to keep pace with the work done along that line by the various State commissions. The Yes Bay (Alaska) station was temporarily closed in order that its allotment of funds might be used to rebuild the water-supply line and make repairs to the hatchery and its equipment, such action being essential to prevent complete deterioration of valuable Government property. In the following pages is given a brief review of the work of the hatcheries on the Pacific coast.

AFOGNAK (ALASKA) STATION.

[EDWIN WENTWORTH, Superintendent.]

There was another excellent run of sockeye salmon in Letnik Lake, and during the active spawning season, extending from July 31 to September 24, 62,300,000 eggs were laid down in the hatchery. This

is the fourth consecutive year that the egg collections have exceeded 50,000,000, and it would seem to indicate the permanency of the reestablished run, which was practically destroyed by the volcanic eruption of 1912. In none of these years do the egg collections afford an accurate index to the numbers of fish entering the lake, as it is the exceptional season when conditions are such as to permit active fishing throughout the spawning season. Thus, many of the fish annually escape to perform the spawning function under natural conditions. During the fiscal year 1920 upward of 79,000,000 eggs were taken, after which the racks were removed from the spawning streams. It was estimated that not more than 50 per cent of the spawning salmon entering the lake were used. During the season of 1921 the egg collections did not fill the hatchery, as floods during August prevented successful fishing.

Of the eggs collected 10,000,000 were transferred to other points, 5,000,000 going to the Yes Bay (Alaska) station, 2,000,000 to Quinault, Wash., and 3,000,000 to the State fish hatchery at Bonneville, Oreg., in continuance of an effort to restock the Columbia River with the species. The eggs retained at the station were incubated with a loss of $6\frac{1}{2}$ per cent. In view of the excellent run of sockeye salmon that has entered Letnik River during the past four years, it may not be amiss to consider the opening of Letnik Bay to commercial fishing for the species after it has been ascertained that a sufficient number of fish has entered the lake to insure a satisfactory number of eggs for artificial incubation. This would involve the installation of a rack, making it possible to count the salmon passing through. It is believed the same rack would be useful in excluding Dolly Varden trout and silver salmon from the lake should this be considered advisable. The water temperature at the beginning of the spawning period registered 52° F.; at its close, 40° .

YES BAY (ALASKA) STATION.

[C. H. VAN ATTA, Superintendent.]

Fish-cultural work at this station was confined to the incubation of the sockeye-salmon eggs transferred from the Afognak station, 4,025,000 fingerlings resulting from the 5,000,000 eggs received. During December 350,000 of the eyed eggs were planted in three local lakes, which have been designated as Cannery Lake, Round Lake, and Lake No. 2. These bodies of water do not at present support a run of salmon, though they appear to be suited to the purpose. A rather casual inspection of the lakes on May 17 disclosed several schools of sockeye-salmon fingerlings from 1 to $1\frac{1}{2}$ inches long. Each school was estimated to contain from 25 to 75 fish.

In view of the extensive repair work in hand it was not possible to take up fish-cultural operations on the usual scale. The repairs were essential to prevent complete deterioration of valuable property and were made from the funds usually allotted for propagation, the special appropriation requested by Congress for the purpose having been refused. The main features of the work consisted in the installation of a new water supply and extensive repairs to the hatchery building, including new foundation piling, new floors, and a complete set of 240 hatching troughs. The water supply required

approximately 4,000 feet of 18-inch and 16-inch wood stave pipe, which was carried on a trestle from 1 foot to 24 feet high, and 1,250 feet of 6-inch pipe to provide water for domestic use and for fire protection. The trestle is made to accommodate a tramcar and makes available for station use an excellent supply of firewood and lumber, also, after the station has been equipped with a sawmill. The work also included repairs to other station buildings and the construction of a new launch. The station is now on an operating basis again, and fish-cultural work will be resumed during 1922.

During the fiscal year 1920 a system of feeding young salmon that had been in successful operation in the Washington field for some time was tried at the Yes Bay station. An arm of McDonald Lake, locally known as McDonald Slough, was temporarily screened, and a considerable number of young sockeye salmon were placed therein. The fish were fed regularly on salted salmon and made a very excellent growth. The results of the experiment were so satisfactory that piling has been driven to make the feeding inclosure a permanent feature of the station's work.

BAKER LAKE (WASH.) STATION AND SUBSTATIONS.

[J. R. RUSSELL, Superintendent.]

Necessity for economy has compelled the suspension of fish-cultural operations at three of the field stations in the Washington group in the past two years, and this has tended to reduce the output in that region. The combined output of the Washington stations for the fiscal year 1921, exclusive of Quinault, is 36,873,015, against 33,086,750 for the preceding year, 20,393,315 of the 1921 figures representing fingerlings, as opposed to a production of 9,842,350 fingerlings in 1921.

BAKER LAKE (WASH.) STATION.

Of particular interest in connection with the fish-cultural work in this field was the excellent run of sockeye salmon at Baker Lake. The run began on July 1, when 115 adult fish were taken, and continued to August 13, the peak of the run occurring between July 20 and 24. A total of 7,850 spawning fish were taken. The spawning period extended from October 10 to November 30. About 46 per cent of the total brood stock, or 3,645 fish, proved to be gravid females and yielded 11,750,000 eggs. This is the largest collection of sockeye-salmon eggs obtained at Baker Lake, exceeding last year's record collection by 600,000. The incubation period was unusually protracted, the first fry appearing on April 1, nearly three months later than in the preceding year, and hatching operations were not completed until May 31. The long incubation season was attributable to low water temperatures, brought about by cold spring weather and late snowstorms in the mountains. Apparently there were no ill effects to either eggs or fry, as the loss of eggs amounted to only 3.6 per cent, while the fry hatched seemed to possess the usual vigor.

Though it has not been possible to replace all equipment destroyed by the fire of last year, all of the fry produced were retained in the hatchery troughs to the end of the sac stage, this being effected through the use of the stacked-tray system. There remained on hand

at the close of the fiscal year 4,000,000 of these young salmon, which will be reared to a larger size before liberating. In connection with its rearing operations the bureau is indebted to the fish and game authorities of the State of Washington, which furnished without charge 1,000 cases of canned salmon "do-overs" to be utilized as food for the fish.

The improved run of sockeye salmon in Baker Lake seems especially noteworthy from the fact that for more than 20 years the maintenance of the run of this species has depended almost exclusively on artificial propagation. It has been the custom at this point to trap all fish as they enter Baker Lake from the river and transfer them to an inclosure near the head of the lake, where they are held until ready to spawn. Thus, only the comparatively few fish which occasionally escape the trap during high-water periods spawn naturally in the lake.

In addition to the sockeye-salmon operations 700,000 silver-salmon eggs were taken between November 17 and December 15. In pursuance of the adopted policy of reserving Baker Lake so far as possible for the propagation of sockeye salmon, these eggs were transferred to the Birdsvew hatchery immediately after being eyed.

BIRDSVIEW (WASH.) SUBSTATION.

The work of the Birdsvew substation, on the Skagit River, was also successful. Its output of chinook salmon was larger than in any previous year, and the collections of silver and steelhead salmon eggs were above the average. This substation is now dependent on the fish that enter Grandy Creek for its egg collections. The trap in Phinney Creek, formerly a valuable egg-producing stream, was destroyed by floods two years ago, and since that time funds for its replacement have not been available. The success of the work at this point is attributed largely to the favorable water stages which prevailed throughout the spawning season. The streams in this locality are subject to sudden and violent fluctuation, and not infrequently at the spawning season the water is at such a low stage as to make the ascent of fish difficult, if not impossible. Of passing interest is the collection of 13,500 sockeye-salmon eggs from fish taken in Grandy Creek, the result, apparently, of plants of that species made by the bureau in Grandy Lake.

BRINNON, DUCKABUSH, AND QUILCENE (WASH.) SUBSTATIONS.

The propagation of chum salmon at the three substations on Hood Canal—Brinnon, Duckabush, and Quilcene—was unusually successful from the standpoint of egg collections and numbers of fry produced. Thirteen million eggs of this species, taken in Walcotts Slough, at the Brinnon substation, represented the largest number of eggs taken in that region. The egg collections do not accurately represent the numbers of spawning fish in the streams, since many escaped during the high-water stages, which were frequent during the spawning period and adversely affected the work at all points on the canal.

There are two distinct runs of chum salmon in the tributaries of Hood Canal. The spawning of the first, or summer run, occurs

in September, while the late or winter run spawns from early November to well into January. A peculiarity of this species is that the fish in most instances are in spawning condition when they leave salt water to enter the streams, and most of the eggs collected in the Washington field are obtained in tidewaters. The increased collections of chum-salmon eggs within the past two years may be attributed to the lessened activity of commercial fishermen, the low prices prevailing offering but little inducement to fish.

There was a satisfactory run of silver salmon at the Hood Canal substations, though egg collections fell below those of the preceding year because the run occurred at a time when floods prevented the successful operation of traps or seines, a condition that continued to prevail throughout the spring spawning season of the steelhead salmon.

QUINAULT (WASH.) SUBSTATION.

[PHILO B. HAWLEY, Foreman in Charge.]

The fish-cultural work at this substation during the year was less successful than usual, the aggregate output amounting to only 5,820,800 as compared with 15,908,600 in 1920. Eggs at this point are obtained from fish taken in traps or by other means in the tributaries of Quinault Lake, which, like most streams in a mountainous country, react quickly to climatic conditions, a heavy rain producing flood conditions almost immediately. The waters rapidly subside on the cessation of rain, while even a short period of dry weather causes low water stages at all points. Fishing operations are conducted in the streams at some distance from the hatchery, the eggs being transported by canoe. Every season there are times when the water stages in the upper Quinault and Big Creek, the principal spawning streams, are so low that it is difficult to operate a canoe, while at other times the water is so high that all traps are submerged to a depth of 1 to 5 feet.

As it is characteristic of salmon to ascend the streams in the greatest numbers during high-water stages, it is not surprising that the egg collections should be subject to material fluctuation from year to year. Thus, the number of eggs of any species taken is not necessarily a just criterion of the number of salmon available at spawning time. The remedy for this situation, from a fish-cultural standpoint, is the construction of a trap at the lake outlet similar to the one used at the Baker Lake station, whereby all the fish are taken as they enter and are held in an inclosure until they are ready to spawn.

The first sockeye-salmon eggs were taken November 3, and between that date and November 20 the entire egg collections for the season, amounting to 1,750,000, were obtained. From November 20 to the time that efforts at spawn taking were abandoned, on December 15, high-water stages precluded all possibility of seining or fishing by other methods. Local collections of this species were augmented by the receipt of 2,000,000 eggs from the Afognak station. The run of silver salmon appeared to be larger than usual, and during the spawning season of that species, which is coincident with that of the sockeye, 1,565,000 eggs were secured. A small number of chinook-salmon eggs was also taken. The run of chinooks, which was apparently not large, was earlier than usual.

The output consisted of 950,000 fry and 3,448,000 fingerlings of the sockeye salmon, including 1,500,000 fingerlings carried over from the preceding year, 1,398,000 silver salmon, and 24,800 chinook fingerlings, with 1,000,000 sockeyes remaining on hand at the close of the fiscal year.

From time to time there has been some criticism regarding the bureau's work at Quinault, particularly on the part of the Quinault Indians. The substation is located on the Quinault Indian Reservation, and salmon fishing is the principal means of support for the Indians. Following the passage of regulations that had the effect of restricting salmon fishing to some extent in the Quinault River, a petition was submitted to the Commissioner of Indian Affairs, expressing the belief of the petitioners that the work of the hatchery had been detrimental rather than beneficial to the fishery of the river. The statement appeared to be founded on prejudice rather than on fact. The results of artificial propagation at other points do not bear out the contention, and in Quinault waters the fish taken for artificial propagation represent but a small part of the fish reaching the spawning grounds, probably not more than 10 per cent in any season. Furthermore, for several years considerable numbers of sockeye-salmon eggs transferred from the Alaska stations have been incubated in the Quinault hatchery and the resulting fingerlings planted in Quinault Lake or its tributaries.

Notwithstanding these facts, it was decided to try an experiment, which it was hoped would furnish reasonably reliable data on the results of artificial propagation as compared with natural reproduction. The plan suggesting itself was to take an accurate census of the sockeye salmon entering Quinault River and Quinault Lake for a period of years and by checking the returns from each year involved to secure at the proper time the desired figures for comparison. During the first two years of this period no artificial propagation of the sockeye salmon was to be conducted, and all fish of that species entering the lake were to be permitted to seek their natural spawning grounds for natural reproduction, this period to be followed by two years of artificial propagation.

Conditions in Quinault Lake and Quinault River are particularly favorable for the conduct of an experiment of this character. A fairly accurate record of the number of fish taken by the Indians as a commercial venture each season is available, and it remained only to obtain a count of the fish escaping the fishing operations in the river as they entered the lake on their way to the spawning grounds. To accomplish this a row of piling was driven across the outlet of the lake, approximately 700 feet at the site selected. Four-inch mesh cotton webbing was attached to the piling in such a manner as to prevent the fish from entering the lake except by way of a 16-foot entrance provided in the weir at the point of deepest water. This entrance was so arranged that the fish were forced to pass near the surface of the water over a strip of white canvas, making them plainly visible to the attendant located in a small building on the piling above. Provision was also made for closing the entrance at times when the observer was not present. The first count was made on April 14, when three sockeyes passed over the counting entrance, and was continued to June 10. The results of the census are indicated in the following table:

Date. ¹	Number of fish.	Date. ¹	Number of fish.
April 14.....	3	May 16.....	118
15.....	1	17.....	405
16.....	16	18.....	30
17.....	1	19.....	19
18.....	3	20.....	255
19.....	3	21.....	11
20.....	23	22.....	788
21.....	0	23.....	103
22.....	9	24.....	65
23.....	2	25.....	171
24.....	23	26.....	129
26.....	3	27.....	228
27.....	2	28.....	962
28.....	1	29.....	299
29.....	44	30.....	656
May 1.....	4	31.....	610
2.....	51	June 1.....	649
5.....	96	2.....	1,685
6.....	1	3.....	563
7.....	20	4.....	238
8.....	151	5.....	13
9.....	18	6.....	853
10.....	11	7.....	196
11.....	246	8.....	826
12.....	421	9.....	164
13.....	230	10.....	90
14.....	82		
15.....	286	Total.....	11,788

¹ No count made on dates omitted.

The count was discontinued and the webbing removed from the piling on June 10 because of the increasing numbers of fish that "gilled" in the 4-inch mesh. This trouble was not anticipated, as the webbing was of the same quality and mesh as that used at the Baker Lake station for a long period of years with entire success, and the 4-inch mesh is in general use for fish traps on Puget Sound. An estimate of the fish entering the lake after the removal of the webbing placed the number at 8,000, or a total of approximately 20,000 for the season. Inasmuch as it was not possible to obtain a complete and accurate record, it was decided to postpone the experiment for another season and proceed with artificial propagation as usual. With slight changes the weir constructed for the purpose described will be of value in connection with fish-cultural work should it be found desirable to continue such work after the conclusion of the experiment. The number of sockeye salmon taken in the commercial fisheries conducted by the Indians in Quinault River during this period amounted to 28,608.

SULTAN (WASH.) SUBSTATION.

At the Sultan substation, on Elwell Creek, there was a falling off in the egg collections of all species as compared with those of the preceding year. This creek is a tributary of the Skykomish River, which joins the Snohomish River at tidewater, some 20 miles from its mouth. This 20-mile stretch of the Snohomish River is subjected to intensive gill-net fishing operations each year, and it is extremely doubtful if the fish which are able to escape the nets during the fishing season, together with those that are given free ascent of the stream during the closed season, are sufficient in number to maintain the run in the watershed.

CLACKAMAS (OREG.) STATION AND SUBSTATIONS.

[H. C. MITCHELL, Superintendent.]

Under this heading are included the four Federal fish-cultural stations in the State of Oregon, two located on the Washington side of the Columbia River, with one egg-collecting station on the Washougal River, also in the State of Washington, and another on the Snake River, near Salmon, Idaho. The aggregate egg collections during the fiscal year 1921 were 42,912,320, and though the chinook salmon predominates in the work all species of the Pacific salmon excepting the sockeye and including the steelhead are represented. The shad is also propagated at Willamette Falls, Oreg., and the output is further augmented by the incubation of eggs of other species obtained by transfer from various points, and the distribution of the resulting fish in Oregon, Washington, and Idaho waters. The species thus transferred consist of brook trout, rainbow trout, blackspotted trout, and sockeye salmon.

In line with the very general belief, which appears to be well substantiated by reliable investigators, that much greater returns may be expected from the planting of larger-sized fingerling fish, particularly in the case of the chinook salmon, it has been the policy to develop facilities as rapidly as possible for this purpose. The stations in the Oregon field have an excellent record in this respect. During the fiscal years 1919-20 and 1920-21, an aggregate of approximately 83,500,000 fish from 2 to 3½ inches long have been planted in suitable waters of the State. These consist largely of the chinook salmon, though, as mentioned before, smaller numbers of brook, rainbow, and blackspotted trouts and steelhead salmon are included.

In contrast with the conditions that obtained during the previous spawning season of the salmon, when low-water stages at all points handicapped the work, floods prevailed in most of the streams during the season covered by this report. While it was not possible to state with accuracy to what extent the operations were curtailed by the floods, there is reason to believe that with more nearly normal weather conditions the aggregate collection of eggs would have exceeded that of any preceding year and that at some points the eggs available would have been in excess of hatchery capacity.

CLACKAMAS (OREG.) STATION.

Though the racks installed in the Clackamas River in connection with operations at Clackamas station were of unusually substantial construction and remained intact through two severe freshets they were carried away on October 3, and the egg-collecting season ended on that date. Though a very fair number of chinook and silver salmon had collected between the racks prior to their destruction, conditions in the river were such as to render the laying out and operation of a seine impossible. Consequently, the egg collections were reduced very considerably, totaling only 360,000 of the chinook salmon. Shad culture at Willamette Falls during July resulted in the collection of 2,119,000 eggs of that species. Transfers of eggs from other points were made as follows: 3,166,000 chinook salmon from Snake River (Idaho) station, 100,000 chinook salmon

from Little White Salmon (Wash.) station, 100,000 blackspotted trout from Montana Fish and Game Commission, 25,000 blackspotted trout from Yellowstone Park, and 197,000 brook trout and 96,000 rainbow trout from Springville (Utah) station.

UPPER CLACKAMAS (OREG.) SUBSTATION.

The spring run of chinook salmon in the Clackamas River was the largest for a number of years, and egg collections of that species at the Upper Clackamas substation exceeded the previous season's record collection by nearly 800,000. Racks were installed early in July and fishing operations continued until September 16, when high water permitted the escape of all remaining fish, probably two-thirds of all the fish intercepted by the racks getting away at this time. There has been a most decided improvement in the annual run of spring chinooks in this stream, and the station, though small, is of importance to the fisheries of the Clackamas River. Because of its exceptionally attractive and convenient location and its well-kept condition it is a point much favored by visitors. Unfortunately, the Clackamas River is difficult to protect against the poacher, and illegal fishing is prevalent.

LITTLE WHITE SALMON AND BIG WHITE SALMON (WASH.) SUBSTATIONS.

There was a lighter fall run of chinook salmon in the Columbia River in the fall of 1920 than has occurred for several previous years. To offset this there were not the intensive fishing operations witnessed throughout the period of the war, and the demand for chum and silver salmon was particularly light. As at all points in the Oregon field, the persistent high-water stages throughout the spawning period rendered the work of the spawn-taking crews difficult and hazardous, and at times the streams were quite beyond control. The run of chum salmon was of fair proportions, but it occurred at a time when it was possible to obtain only a limited number of eggs, and only a small proportion of the fish were obtained for propagation. During the run of silver salmon the floods were so severe as to make fishing impossible; therefore no eggs of this species were recorded.

The collections of fish eggs at the Little White Salmon substation for the year consisted of 16,950,000 chinook salmon (of which 2,000,000 were sent to the Big White Salmon substation and 1,100,000 to the Clackamas station) and 5,162,000 chum-salmon eggs. This substation also handled 30,000 sockeye-salmon eggs transferred from the Washington field. At the Big White Salmon substation 5,005,000 chinook-salmon eggs represent the total egg collections.

ROGUE RIVER (OREG.) SUBSTATION.

Operations at the Rogue River substation suffered less from the prevalent floods than at any other point in the field, and 4,438,000 chinook salmon, 506,000 silver salmon, and 121,500 steelhead salmon eggs were secured. There were on hand at the beginning of the year 49,500 blackspotted trout, 886,000 steelhead salmon, and 197,000 rainbow trout fry, all of which entered into the distribution from the station later in the year.

APPLEGATE (OREG.) SUBSTATION.

At the other substation in southern Oregon, on Applegate Creek, the rainfall was excessive, and while higher water stages are frequently witnessed in the stream than occurred at any time during the season of 1921 still the amount of water carried during the year was unusually large. Placer mining at points on the creek above the station has resulted in large deposits of gravel at the fish barrier which will necessitate some changes before the next spawning season. Egg collections were unusually light, as most of the spawning fish escaped over the racks. The results of the season's egg collections were 80,000 chinook salmon, 36,000 silver salmon, and 55,000 steelhead salmon.

WASHOUGAL RIVER (WASH.) SUBSTATION.

The substation on Washougal River was opened on April 15, and 359,000 eggs of the steelhead salmon were obtained. High water and the lumber work on the river were both sources of trouble and interfered with the egg-collecting work. From the collections shipments of eyed eggs were made to the New York Conservation Commission, to the Clarke County Game Commission at Vancouver, Wash., and to the Montana Fish and Game Commission in exchange for blackspotted trout eggs.

Some unusual features have been observed in connection with the work at this point. Last season it was noted that the fish remained quietly in the pools below the dam, showing but little inclination to ascend the river. Furthermore, the eggs secured were of poor quality, only 29 per cent of them producing fry. It is doubted if eggs of first quality were obtained from any of the female fish handled. The cause of this unsatisfactory condition was not ascertained, but the theory was advanced that the newly erected dam which stops the fish many miles below their wonted spawning grounds was responsible. In view of the excellent quality of the steelhead eggs taken at other points under very similar conditions, this theory is not altogether tenable. During the season of 1921 the quality of the eggs obtained was much better, though a considerable number of fish were taken in which small undeveloped eggs were distinguishable. There was nothing in the appearance of the fish to lead one to suppose they would spawn during that season. It is a condition not previously observed at any point, and it is more or less perplexing. It may be analogous to recorded instances of Atlantic salmon seeking their spawning grounds in fresh-water streams a full year in advance of the time they were ready to perform the spawning function and remaining there until that purpose was accomplished.

SALMON (IDAHO) SUBSTATION.

The results of the season's work on the Snake River were very satisfactory. The racks were installed in Lemhi Creek before the end of the fiscal year 1920, and a good run of fish appeared early in July. Spawning began on August 14, and between that date and September 1, 6,000,000 eggs were secured, filling all available space in the eyeing station troughs. Immediately after this the racks were removed, and the fish remaining in the stream were permitted

to ascend to their natural spawning grounds. It is probable that the numbers of fish thus released for natural spawning exceeded those involved in the egg collections. This substation is located within 10 miles of the "top" of the Rocky Mountains, in the State of Idaho, and to reach this mountain stream for the accomplishment of their supreme mission in life the salmon travel approximately 1,500 miles without food after entering the Columbia River at Astoria, Oreg. The conditions which were observed here in regard to the splendid spring run of chinook salmon were not confined to the Snake River. Similar conditions were observed in all tributaries of the Columbia River frequented by the so-called spring-run fish.

Very excellent results in the rearing of young salmon have been obtained from the use of a comparatively new article of fish food. This is the immature spawn of the salmon taken by the commercial fishermen. The spawn is purchased at a comparatively low cost and held in cold storage until needed. In commenting on its value in his annual report for 1920 the superintendent of the station states:

The salmon fry fed on salmon spawn and beef spleen produced remarkably fine fingerlings. It is by far the most satisfactory food that has ever been used in this field. No trouble was experienced with the fish at any point where its use was adopted. They were uniformly sturdy and readily accepted it throughout the year.

While the expense involved in feeding fish on an extensive scale is considerable, in view of the quite general belief that the future supply of salmon in the Columbia and other rivers of the State is dependent very largely on the numbers of fingerling fish released from the hatcheries, the work is considered of first importance. Because of the long period during which so little is known of the life of the salmon—from the time of the seaward migration as a fingerling or yearling until its return for the reproduction of its kind—it is difficult to effect any positive check on the actual results of hatchery work. Nevertheless, the evidence in favor of the work at certain points, notably in the Columbia, Clackamas, and Rogue Rivers, is of a convincing nature, and it appears to fully warrant the expense necessary to continue the feeding and intelligent planting of fingerlings. Upward of 68,000 pounds of fish food was used at the stations in the Oregon field during the fiscal year 1921. The details are given in the table of fish food on page 75.

BAIRD (CALIF.) STATION AND SUBSTATIONS.

[W. K. HANCOCK, Superintendent.]

In this field are to be recorded a number of untoward circumstances resulting in a serious curtailment of the fish-cultural work. From the fall run of fish the aggregate egg collections for the entire field amounted to 7,910,000, as compared with 11,785,000 the preceding year, which included 1,349,700 eggs of the spring run chinook salmon taken in the McCloud River at Baird.

Racks were again installed in the McCloud River in time to intercept the spring run of chinooks, but no fish appeared. This is directly attributable to the dam erected in the Sacramento River at Redding for irrigation purposes. This dam had the effect of diverting into the irrigation ditches most of the water in the river during periods of low-water stages, and though an opening was left in the

dam to permit the passage of fish it was never effective. The matter of providing a suitable fishway was taken up with the California Fish and Game Commission, and at the close of the year the case was pending in the courts.

There was a very large run of fall chinooks in the Sacramento River, and while the early fall was marked by low-water stages it was estimated on November 15 that there were enough fish impounded at the Battle Creek substation to yield not less than 15,000,000 eggs. At Mill Creek the run was even larger, and the egg collections for that substation were estimated at not less than 30,000,000. Beginning November 20 several days of heavy rains occurred, bringing about flood conditions of unusual severity. Many miles of territory, including railroads and highways, were under water. The retaining racks at all points were destroyed and spawning operations abruptly brought to a close.

At the Battle Creek substation 2,450,000 eggs were taken, of which 504,000 were transferred to Baird for incubation and 20,000 shipped to central station, Washington, D. C., for exhibition. The remainder were hatched successfully, and 1,781,000 fingerling fish were planted in Battle Creek. At the Mill Creek substation 5,460,000 eggs were secured, of which 1,000,000 were shipped to Baird and 3,000,000 to the State hatchery at Sisson. From the remainder 1,347,400 fingerling fish were produced at the station.

INVESTIGATIONS AND EXPERIMENTS.

FERTILIZATION OF SALMON EGGS IN NATURAL SPAWNING.

At many points on the Pacific coast certain species of salmon, notably the humpback and chum, spawn at or near the mouths of streams in tidewater. A rather general belief has existed that the results of such natural spawning were negative, and in order to obtain information on the subject the field superintendent in charge of the Pacific coast stations and the superintendent of the Baker Lake (Wash.) station were detailed to investigate these conditions in Puget Sound. The report of their findings follows:

In conformity with instructions relative to securing information on the percentage of fertilization of salmon eggs in natural spawning, with special reference to the eggs deposited in places over which the tide ebbs and flows, an investigation was made of Walcott Slough, at Brinnon, Wash., on March 5, 1920.

Walcott Slough runs through extensive tide flats, which at flood tide are completely covered with salt water. During ebb tide a good flow of fresh water, estimated at about 3,000 gallons per minute, passes through the slough, its source being spring seepage at the slough head. The fish—chum salmon with a few silver salmon—enter this slough to spawn, the entire slough bottom being composed of gravel suitable for the purpose. The bureau has a rack and trap installed at a favorable point in the slough, about 500 yards from salt water, where fish are captured for propagation. Below the rack some natural spawning occurs, and this occupied our attention. Several nests were investigated, all but two of which contained eggs. These two might possibly have been made last year, though they had the appearance of being used quite recently. Eight nests were examined, beginning with No. 1 (see table, p. 28) just below the trap, about 500 yards from salt water at low tide, and ending with No. 8, about 200 yards from the same water stage. During flood-tide periods salt water covered the nests from three to six and three-fourths hours to a depth of $1\frac{1}{2}$ to $5\frac{1}{2}$ feet. This will vary somewhat with higher or lower runs of tide.

The condition and character of the bottom wherever nests were found would indicate that the fish chose points where spring seepage occurs through

gravel from 1 to 4 inches in diameter. Here the eggs were buried from approximately 8 to 16 inches deep. When the eggs were reached, the gravel was found to be absolutely clean, more especially where the good eggs were secured, with a coating of fine sediment on top, indicating a circulation of fresh spring seepage water at all times. Anticipating this condition, a common trough was installed in the slough, with a circulation of fresh water assured at a low tide, but which at flood periods would be covered from 1½ to 4 feet with salt water without any circulation. The trough was filled with gravel, through which about 25,000 eggs were carefully mixed. A tight cover was then fastened on the top, with sufficient space left at both ends for proper circulation. The eggs were placed in the gravel on December 18, 1919, immediately after being fertilized, and on examination, on March 5, 1920, they were found to have hatched with an estimated loss of about 30 per cent. The fry appeared to be extremely active and healthy. The bad eggs were nearly all decayed and broken but had the appearance of having been fertilized and the embryo partially developed.

This would lead us to believe that an entire salt-water supply, with as low a density as 1.010 for an extended period, is injurious but not absolutely fatal, and it strengthened our belief that where fish spawn naturally within tidewater area the eggs are deposited where they receive a circulation of fresh water, as before stated. Samples of eggs were taken from each nest, and, contrary to Mr. Robertson's theory and observations in hatching eggs in gravel, the infertile eggs were chalky white when first observed in the gravel. The alternating salt and fresh water may be a contributing cause, though where a continuous circulation of fresh water seeps through the gravel it would appear difficult for salt water to penetrate sufficiently to have much influence on the eggs.

Our observations led us to believe that the infertile eggs might be accounted for largely by a scarcity of male salmon. However, there is a possibility that spawning might have occurred wholly in salt water, which may prevent the action of the eggs necessary to proper fecundation. As all but a few of the fish entering the slough were taken in the trap, and as the males are usually the first to ascend, it is not improbable that most of the males entered the trap, thus reducing the possibility of successful natural spawning at the points where observations were made. The table would indicate enormous losses through natural spawning, but as conditions were not absolutely normal, we would not care to be too emphatic from this meager survey.

To obtain full information relative to the foregoing it would be necessary to extend observations over the entire spawning season. Each nest should be marked and accurate data produced as to the number of fish depositing in each nest, together with all natural and unusual occurrences noted.

RESULTS OF EXAMINATIONS OF FISH NESTS, WALCOTT SLOUGH, BRINNON, WASH.,
MARCH 5, 1920.

Nests.	Distance from salt water at mean low tide.	Height of tide over nest at mean high water.	Water density, high tide.	Vertical rise of tide on reaching nest.		Length of time tide covers nest.	Estimated number of eggs per nest.	Condition of eggs.	Remarks.
				<i>Ft.</i>	<i>In.</i>	<i>Hrs.</i>			
No. 0 box ¹	550	1 7	1.018	7	8	3	25,000	Hatched...	Estimate 70 per cent hatched.
No. 1 ^{1,2}	500	2 5	1.022	6	8	6	46	Good.....	41 good; 5 dead.
No. 2 ^{1,2}	450	2 1	1.022	7	0	4½	100	Total loss.	Unfertilized.
No. 3 ^{1,2}	450	2 1	1.022	7	0	4½	151	Perfect.....	1 dead, but all fertile.
No. 4 ³	420	3 1	.....	6	0	6½	500	Total loss.	Unfertilized.
No. 5 ³	410	3 1	.....	6	0	6½	200	do.....	Do.
No. 6 ³	300	4 7	.....	5	6	6½	402	Very poor.	400 dead; 2 good (bad, unfertile).
No. 7 ³	250	4 7	.....	5	6	6½	.....	.....	Nest looked good, but contained no eggs.
No. 8 ³	200	5 7	.....	3	6	8	.....	.....	Do.

¹ The salt water density was tested by pumping water from bottom over nests at flood tide and ranged from 1.018 at box location to 1.022 at nests Nos. 1, 2, and 3, and 1.025 natural sea water in Hood Canal.

² Planted.

³ Nests 5 feet apart.

Current swift and water badly discolored; numbers estimated from those seen in the water and caught in net and baskets set below the nests on the riffles when disturbing eggs; good eggs are not as buoyant as dead ones, and therefore some may have escaped our notice.

HATCHING EGGS IN GRAVEL.

At the Afognak (Alaska) station an experiment in hatching eggs in gravel after the so-called Robertson method was undertaken during the season of 1920. Eggs to the number of 5,500,000 were placed in two old hatching troughs, mixed thoroughly with gravel, and bedded in the bottom of the creek. The troughs were fitted with a cover and water was introduced through a 1-inch pipe leading from a small dam, so that there would be a gradual flow through each trough. The intake of this pipe was carefully protected by a screen.

On opening the troughs in the spring it was found that very few of the eggs had hatched. Though the winter was a mild one it is probable that the eggs had been frozen, as there had been a very light fall of snow, leaving the creek unprotected, and frost may have penetrated to a greater depth than in seasons of lower temperature. Eggs placed in gravel boxes patterned after the Robertson plan and held in the hatchery developed nicely, and the majority of the fry remained in the gravel until the yolk sac was absorbed.

SUGGESTIONS FOR POSSIBLE IMPROVEMENT AND ENLARGEMENT OF WORK.

Further extension of the feeding operations at all stations where chinook, sockeye, and silver salmon are handled is desirable. This would necessitate an increased allotment for the Pacific coast work, since at the present time there is not sufficient capacity or funds to feed all stock resulting from the eggs collected. In fact, it has been necessary to close certain substations and curtail expansion in all fields. The extension of operations in other fields is essential if the work is to be kept at its highest efficiency. The take of eggs at many of our stations has been reduced through extensive commercial fishing operations during the period of the war, when heavy demands were made for this class of food, and it will take many years to restore the streams to their former productiveness.

The small statutory salaries provided for the lower grades of the bureau's service and the consequent inability to maintain a trained and efficient personnel have been important factors in the declining output. Because of these conditions it has been necessary to employ and train new men at most points every season, and as competent men could not be secured or retained at the statutory wage provided station allotments have been drawn upon in many instances for the employment of temporary help at the prevailing high wages, thus greatly reducing the funds available for actual propagation work.

The returns from the marking of young salmon on the Columbia River and at other points have not been wholly satisfactory. One reason for the small returns from these experiments may be the fact that it has been the custom to hold the fish intended for marking for several months beyond the natural spring migration, and this may have had a serious effect on the life of the fish involved. The thought has occurred that better results might be secured if the fish used in the marking experiments are held over one year, or until the migration of the following spring. The results of the marking experiments also suggest the desirability of a more thorough study of the early life of the salmon, with the view of correcting any possible weaknesses in present methods of propagation and distribution. This is a phase of the work that is respectfully referred to the division of scientific inquiry.

One of the greatest needs in connection with Pacific salmon propagation is more adequate protection for the fisheries through the enactment and rigid enforcement of restrictive legislation. The regulations should provide (1) for the return to the waters uninjured of all immature fish that may be taken in nets or other fishing devices; (2) for a weekly closed season, thus assuring ascent to the natural spawning grounds of a certain proportion of the unripe fish; (3) for cessation of fishing operations after the canneries have put up a fixed number of cases, the limit of the pack to be determined by investigations in each locality, which must be such as will permit the escapement of a sufficient number of fish to insure continuation of the run in each locality; (4) for systematic destruction of Dolly Varden trout in salmon streams, these fish having been found to be among the greatest enemies of young salmon; (5) for setting aside natural lakes for use as salmon-rearing reservoirs; (6) for seeding of eyed salmon eggs in the more inaccessible lakes, in order that the young may pass the early stages of their existence in waters which are comparatively free from natural enemies. During periods of flood the fish in these lakes would pass from them over slight falls and through the intervening rapids, entailing little loss. In certain barren lakes the application of such a plan would necessitate the provision of a food supply. Work of this character has already been undertaken in a limited way in the vicinity of the Yes Bay (Alaska) station.

The tray system recently introduced in connection with the propagation of salmon at the western stations is proving a very important factor in the work. The eggs are carried in the regular baskets until within two or three weeks of the hatching period, when they are transferred to 14 by 16 inch trays, made of 1 by 1½ inch lumber and covered with wire cloth 14 to 16 meshes to the inch. From 3,500 to 4,000 sockeye-salmon eggs are placed on one of these trays. The trays are stacked from 6 to 8 deep in a trough compartment, thus increasing the holding capacity of a 16-foot trough from six to eight times and permitting the safe development of 300,000 to 400,000 fry in a space which was formerly required for 50,000. The fry are carried in dark, deep pockets, with the view of providing, so far as possible, the seclusion afforded in natural hatching, as it is believed they will develop under such conditions all the characteristics of gravel-hatched fry.

Another favorable feature is the more compact arrangement of the hatching apparatus, which permits of a much better control of the fry than under the basket and open-trough system. While it is entirely practicable to spread the green eggs on the trays directly and continue using them throughout the incubation period and up to the time the fry are ready to be fed, it has been found more satisfactory to carry the eggs in the baskets to the point of hatching and then transfer them to the trays, as such an arrangement permits of a thorough cleaning of all apparatus involved. Writing in regard to the use of this system, C. H. Van Atta, superintendent of the Yes Bay (Alaska) station, states:

Sixty thousand sockeye-salmon fry were placed on 12 trays, each 13½ by 25 inches in dimensions. The trays were stacked in one regular basket com-

partment of the hatching trough and held thus from March 12 until the yolk sac had been completely absorbed, on June 7. The total loss of fry during this period was 180.

Without the trays only about 50,000 salmon fry can be safely carried in a standard 16-foot hatching trough through the sac stage. It would therefore appear that by the use of this system the fry capacity of each trough is increased by approximately 200 per cent. J. R. Russell, superintendent of the Baker Lake station and its auxiliaries, in the State of Washington, writes:

The stacked tray system for holding fry during the sac stage was tested this year for the first time, 1,000 of the trays being in use at the Baker Lake hatchery, with 11,000 fry to a tray and 4 trays in each basket compartment, making a total of 264,000 fry per trough. The system proved an entire success. The loss was small. The danger from smothering, which sometimes occurs when large numbers of fry are held on the trough bottoms, appeared to be entirely eliminated, and the "paddling" of the fry, which is essential in the trough, is rendered unnecessary.

From this statement the trough capacity appears to be even greater than was indicated by the experiment at the Yes Bay station. During a period of water scarcity at the Baird (Calif.) station the trays were successfully used to economize in space and water.

PROPAGATION OF FISHES OF THE GREAT LAKES.

The bureau's work in the propagation of the commercial species indigenous to the Great Lakes extends from the Rainy Lake region, in Minnesota, to Lake Champlain, in Vermont. Under existing conditions the work in this field fails of its fullest efficiency through a lack of adequate facilities. An example of this condition is suggested in the possibilities that exist in the propagation of pike perch. In the Rainy Lake field, where pike-perch propagation has been tried in a tentative way, arrangements may be concluded with the Minnesota Fish and Game Commission for the establishment of a small inexpensive hatchery, to be operated jointly by the bureau and the State as an adjunct of the Mississippi Valley work.

Another important pike-perch field awaiting development is in Saginaw Bay, Mich., this region offering greater returns for a given expenditure of funds than any other of which the bureau has knowledge. With an inexpensive but well-equipped hatchery, located in the lower section of the bay, the bureau would be in a position to save the immense numbers of eggs—estimated to be over a billion a year—which are now being sent to market in the fish and lost.

At the pike-perch substation located near the head of Lake Champlain, at Swanton, Vt., large numbers of pike-perch eggs are lost every spring because of inadequate facilities. Before any appreciable improvement can be expected at this station it will be necessary to provide an efficient penning system, so that the large numbers of partially ripe fish taken by commercial fishermen may be held under favorable conditions awaiting the full development of their eggs.

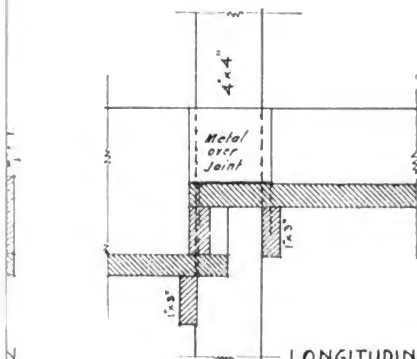
So far as the propagation of whitefish, lake trout, and cisco (lake herring) is concerned, there has been no notable change in recent years either in methods pursued or the fields occupied. Probably the greatest improvement in this branch of the work, both as regards

equipment and extent of territory covered, has been in connection with the operations at the Cape Vincent (N. Y.) station. Within the past year the capacity of the hatchery at that point has been increased approximately 150 per cent without increasing the floor space, this being made possible by the construction of a new and compact type of battery for the glass jars used in the incubation of these eggs. A cut of the battery showing the placing of jars and other details is shown herewith in Figure 1. The scope of the station's field operations has been materially enlarged through close cooperation with the New York Conservation Commission and the Dominion and Provincial fisheries authorities of Canada. At the present time the most prolific field occupied is in the vicinity of the Bay of Quinte, on the Canadian side of Lake Ontario.

The great need in all branches of fish conservation is effective, stringently enforced protective legislation. Simple, easily understood, and easily remembered fishery laws are always desirable, but in the Great Lakes regions the fault probably lies not so much in the character or wording of present laws as in the lax enforcement of legislation now on the statute books. A close season, varying in length to meet local conditions, should be established for all species in the Great Lakes region, and no commercial fishing should be permitted until 40 per cent of the fish on the fishing grounds are in spawning condition, this fact to be determined by the use of set nets operated under supervision. The State laws should provide that commercial fishermen operating during the spawning period be required to turn over free of charge to designated agents of the bureau or the State the ripe eggs of all fish taken. In the framing of the laws more stress should be laid upon the legal size of fish than upon the size of the mesh of seines or nets, and a moderate percentage of small fish should be allowed. In connection with this feature of the work the importance of uniform laws governing all persons alike in a given locality is not to be overlooked. In order to bring about the greatest good, such laws must in their application be not only interstate but international.

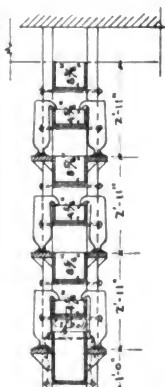
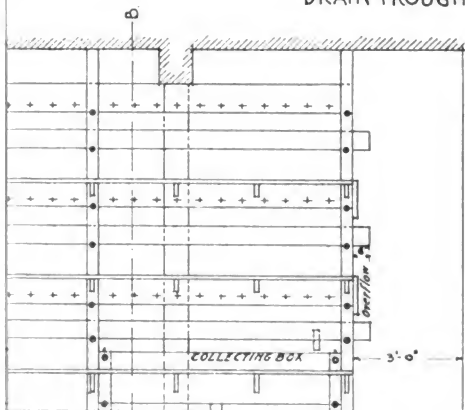
The aggregate output of this group of stations, including the hatchery on Lake Champlain, where pike perch and yellow perch are propagated, amounted in round numbers to approximately 1,158,000,000 eggs, fry, and fingerlings, as against 886,000,000 in the preceding year. The increase may be attributed largely to more favorable weather conditions prevailing throughout the spawning seasons of the species handled. By way of contrast in climatic conditions as they affect fish culture, the work in the Great Lakes region during the spawning season of 1920 suffered generally from severe cold and violent storms. During the spawning season of 1921, while stormy weather was encountered at certain points, the work was interfered with principally by unseasonably warm weather, resulting in water temperatures too high for the best results in artificial incubation.

This branch of fish culture has for many years received the heartiest support of the interests most directly benefited by the work, and that these interests still have faith in the efficacy of artificial propagation is evidenced by the many letters received from them, commending the work and urging its extension. While the figures given for the output of the Great Lakes represent largely such commercial

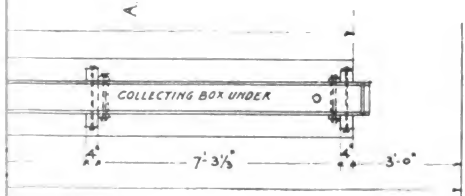


TROUGH

LONGITUDINAL SECTION
AT JOINT BETWEEN SUPPLY &
DRAIN TROUGH.



SECTION A-B.



signed by J. P. Snyder.)

100267°—22. (Face p. 32.)



species as the whitefish, lake trout, cisco, pike perch, and yellow perch, they also include brook trout, rainbow trout, and smallmouth black bass, which species are produced in limited numbers at several of these stations.

DULUTH (MINN.) STATION.

[S. P. WIRES, Superintendent.]

The spawning season of the lake trout in Lake Superior fields, on which the Duluth hatchery depends for its stock of eggs, began about four days later than usual at nearly all points, the bulk of the eggs being taken between October 17 and November 1, though in the vicinity of Isle Royale, Mich., small lots were secured at intervals from the last week in September to about the middle of November. The run of fish was irregular and the egg collections light, the total aggregating only 12,726,500, or little more than half the take of an average season. On account of unseasonable weather and water conditions, poor transportation facilities, and a lack of ice at some of the more isolated fisheries, the quality of the eggs obtained was so impaired as to cut down the output of lake trout from this station to a total of 6,379,500, of which 175,000 were eyed eggs, shipped on assignment to other hatcheries, 6,057,000 fry, and 147,500 fingerling fish.

In the course of the lake-trout spawning season 940,000 whitefish eggs were collected in the Isle Royale field, and on January 6 this number was augmented by the receipt of 10,000,000 eyed eggs of very good quality from the Put in Bay (Ohio) hatchery. The combined stock yielded an output of 9,600,000 fry, all of which were planted in good condition, in various parts of Lake Superior. The station also distributed the product of 150,000 brook-trout eggs received from a commercial hatchery in New England and two consignments of rainbow-trout eggs, aggregating in the neighborhood of 100,000, the latter being transferred to the station from western hatcheries of the bureau.

In cooperation with the Minnesota fisheries authorities the force of the Duluth station established and operated two field stations for the collection of pike-perch eggs during the spring—one on the Rat Root River and the other on Boy River, a tributary of Leech Lake. The bureau's share in the proceeds of these operations amounted to 13,680,000 eggs. At Boy River the work was not altogether successful, as more than 98 per cent of the fish taken had deposited their eggs previous to capture. This may have been due to the unusually low water stages that obtained in the early part of the season, the fish not being attracted to the streams and spawning in the shallow waters of Leech Lake.

NORTHVILLE (MICH.) STATION AND SUBSTATIONS.

[W. W. THAYER, Superintendent.]

There was a further decrease in the number of whitefish and lake-trout eggs secured from Lakes Michigan and Huron, two causes for which are assigned—the State laws and inexperienced and unreliable spawn-takers. Under the present laws fishermen are permitted to use an unlimited number of nets during the fishing season and are not required to make any provision for the salvage of ripe eggs taken.

The effect of this is that so many nets are operated by the fishermen that they are not able to lift them at proper intervals, and the fish taken are either dead or the quality of their eggs impaired. During the spawning season in the fiscal year 1921 there was a good catch of fish and weather conditions were generally favorable, but for the reasons stated the egg collections were unsatisfactory, both as to quantity and quality. This applies to both the lake trout and the whitefish. The egg collections amounted to 30,876,000 of the lake trout and 12,080,000 of the whitefish, and all of them were incubated at the Charlevoix hatchery. The loss on the former amounted to 59 per cent and on the latter to 51 per cent. The output of the station was augmented by the transfer of 59,120,000 whitefish eggs from the Put in Bay station and 25,000 steelhead eggs from the Birdview (Wash.) field, the fry from both lots entering into the general distribution.

The pike-perch work on Saginaw Bay was fairly successful, but it does not represent by any means the potential value of this region as an egg-collecting field. The spawning season extended from March 26 to April 16, during which period 284,290,000 eggs were taken. Of this number 54,050,000 were deposited on the spawning grounds after being fertilized and 223,200,000 were sent to the Detroit hatchery of the Michigan Fish Commission for incubation. The importance of the work in this field has been mentioned on several occasions and funds should be forthcoming to place hatchery facilities in this field for the full development of the work.

From the Northville station there were distributed 475,000 brook-trout fry and fingerlings, resulting from eggs purchased of commercial fish-culturists, and 90,500 rainbow trout were produced from eggs transferred from the West Virginia and Missouri stations of the bureau. Approximately 31,200 smallmouth black bass reared from the Northville station brood stock were also distributed, and at the close of the year there remained in the station ponds about 75,000 bass and 2,000 rainbow-trout fry.

PUT IN BAY (OHIO) STATION.

[S. W. DOWNING, Superintendent.]

Owing to quite generally favorable weather conditions in Lake Erie and to the close cooperation of the commercial fishermen, the whitefish work of the Put in Bay station resulted very satisfactorily, though the spawning season was unusually late. Between November 20 and December 12 eggs to the number of 376,500,000 were collected from fishermen operating in the various fields and placed in the Put in Bay hatchery. Of these, 141,060,000 were secured in the vicinity of Port Clinton, Ohio; 93,840,000 at Isle St. George; and smaller numbers from the fisheries around Toledo, Middle Bass Island, and Catawba Island. In the former prolific whitefish field near Monroe Piers, Mich., no eggs whatever were obtained, as fishing operations were brought to a close very early in the spawning season by a heavy and protracted wind and rain storm which came on just as preparations had been completed for the penning of the partially ripe fish. Shipments of green and eyed eggs aggregating 139,870,000 were forwarded to various State and Federal hatcheries and 7,000,000 fer-

tilized eggs were deposited on the reefs where taken. The remaining stock produced 167,500,000 fry, which were liberated on the spawning grounds in the lake, care being taken to scatter them over as wide an area as possible. The incubation period was shortened by the unusually mild winter, averaging only 119 days, in a mean temperature of 38½° F.

The high-water temperatures prevailing during most of the winter brought on a run of pike perch in March, and some of the commercial fishermen reaped very good returns during the latter part of that month. No spawning fish were in evidence in March, however, and the run throughout the entire season was characterized by the very small number of spawners included in it. Egg-collecting operations extended from April 5 to April 24, but the number of eggs taken was proportionately small. Despite the fact that the fishermen were willing and anxious to act on any suggestion with a view to obtaining good eggs, the quality of the eggs was uniformly poor, being about the poorest, in fact, ever noted in eggs handled at the station. The total of 111,600,000 laid down in the hatchery yielded only 12,600,000 fry. These were strong and active, however, and the entire output was liberated in good condition on the spawning grounds in the lake.

Soon after the middle of May the carp propagation work, inaugurated two seasons ago in connection with the Port Clinton fisheries, was taken up, a small hatching battery for the purpose being set up in one of the fish houses at that point. During the egg-collecting period, extending from May 23 to June 11, spawn takers made daily visits to the fishing grounds to take eggs from the ripe fish landed in the seines, liberating at the same time the fry hatched from earlier lots. The catch of carp was below that of a normal season, but the egg collections were considerably larger than in either of the two previous seasons, the total amounting to 74,325,000. From this stock 63,325,000 fry were hatched and planted on the spawning grounds in the Portage River, between Port Clinton and Oak Harbor.

During the fall, arrangements were made with local fishermen on Lake Erie to save all smallmouth black bass taken in their seines and hold them in live boxes until a sufficient number could be secured to warrant a shipment. By this means 805 adult fish of that species were collected during October and forwarded to various pond fish-cultural stations of the bureau to serve as a brood stock.

CAPE VINCENT (N. Y.) STATION.

[J. P. SNYDER, Superintendent.]

During the first half of November lake-trout eggs to the number of 549,000 were taken at points on Stony Island, N. Y., and Pigeon Island, on the Canadian side of Lake Ontario. As is usual at that time of the year, stormy weather was encountered and all of the eggs were obtained during but four days of weather suitable for fishing. Thirty-nine thousand eggs were shipped to applicants, and of the 450,000 fry hatched from the remainder 80,000 were furnished for stocking interior waters in the State of New York and 370,000 were returned to Lake Ontario waters. Collections of whitefish eggs from Lake Ontario amounted to 150,200,000.

The collecting operations for both lake trout and whitefish were conducted in American and Canadian waters under the same co-operative agreement that was effective last season. In Canadian waters the work was handicapped by lack of a suitable boat, making it necessary to plant on the spawning grounds immediately after fertilization 29,650,000 of the eggs taken at Deseronto and Big Island. Canadian hatcheries received 30,000,000 of the eggs obtained, in accordance with the terms of the agreement; 29,300,000 were turned over to hatcheries of the New York Conservation Commission and 1,000,000 were diverted to the Washington exhibit. The remainder were incubated at the Cape Vincent station and the resulting fry planted in Lake Ontario waters. Egg collections of cisco (lake herring) from Ontario waters totaled 317,200,000, of which 73,200,000 were obtained in Canadian waters at Deseronto and Bygotts Point. The fisheries authorities of Pennsylvania and New York received 104,410,000 and 65,000,000, respectively; 17,100,000 fertilized eggs were planted on the spawning grounds, and the fry hatched from the remainder were returned to Lake Ontario waters.

During the spring a small number of brood yellow perch were obtained from trap nets set in the St. Lawrence River, and from the 15,000,000 eggs thus secured 11,000,000 fry were hatched and returned to the St. Lawrence River. A consignment of 8,000,000 eyed pike-perch eggs received from the Lake Champlain hatchery yielded for distribution 7,970,000 fry of excellent quality, an usually high percentage. In addition to the commercial species enumerated 150,000 rainbow-trout eggs from the bureau's Virginia station and approximately 450,000 brook-trout eggs from commercial dealers were incubated and the fry distributed to applicants in New York State.

A boat suited to the needs of the station was obtained by transfer from the Navy, but because of the time consumed in making needed repairs to motors was not available for service during the past season. When fully equipped, this boat will add much to the productivity of the station, being particularly valuable in connection with the whitefish and cisco work in Canadian waters.

SWANTON (VT.) SUBSTATION.

[A. H. DINSMORE, Superintendent.]

The work at this point is conducted cooperatively with the State of Vermont. During the operating season of 1921, extending from March 2 to May 10, pike-perch eggs to the number of 112,312,500, also 43,950,000 yellow-perch eggs, were secured for incubation. The winter being unusually mild, the Missisquoi River was open at an early date. Nets were set during the first part of March and hauled at frequent intervals at the various points to anticipate the presence of fish. The first pike perch were taken at Sandy Point March 25 and at Campbell's on April 4. Three trap nets were in operation at the mouth of the river, but the results from their use would not appear to warrant their continuance. All fish taken were immediately transferred to the inclosure for ripening, but because of low water stages, resulting in an improper circulation of water through the inclosure, the mortality was high, and all brood fish on hand were released on

April 20. A cold spell in April, following the warm weather of March, caused a protracted incubation period for the pike-perch eggs. In this connection it is interesting to note that while the egg collections were made during the period from April 6 to 20 there was very little difference in the dates on which any lot of eggs reached the eyed stage or completed incubation. The eggs were of extremely poor quality, the loss during incubation being in excess of 77 per cent.

Collections of yellow-perch eggs were in progress from April 21 to April 23. Of the 43,950,000 taken 12,000,000 were delivered to the State hatchery at Burlington, Vt. The remainder were incubated with but slight loss. Upward of 33,000,000 of the pike-perch eggs were shipped to applicants, 14,700,000 going to hatcheries in the State of Vermont.

PROPAGATION OF YELLOW PERCH, BRYANS POINT (MD.) STATION.

[L. G. HARRON, Superintendent.]

Fish-cultural operations were undertaken at this point on March 1, the work being addressed to the propagation of the yellow perch. Between the 3d and the 10th of March 18,226 brood fish were taken. Spawning occurred between the 10th and the 23d of March, resulting in a total collection of 172,630,000 eggs of excellent quality. Of these 2,600,000 were shipped to Washington, where they served as an exhibit during incubation, the fry being used to supply applicants in Virginia. The remaining eggs were incubated in the hatchery, producing 158,819,450 fry, which were planted on the spawning grounds.

MARINE FISH CULTURE.

The season's work in this field may be considered satisfactory, the output of eggs and fry comparing favorably with that of the year previous. While there was a falling off of nearly 50 per cent in the output of cod as compared with last year, this is compensated for by satisfactory increases in the production of other species, notably the haddock. The work during the past season was extended to include the pole flounder (*Glyptocephalus cynoglossus*), a species not previously propagated. This fish, locally known as the "gray sole," has only recently been introduced in the markets of New England. Its existence in these waters has long been known, but previous to the use of the otter trawl in the shore fisheries it was not generally known to fishermen. Because of its small, weak mouth it was not taken on the trawl lines. It has since proved to be a popular fish, commands a high price in the markets, and a fishery of importance is being built up in connection with it.

Inadequate funds have prevented the development of possibilities for valuable work in the conservation of the large number of eggs of the marine fishes that are annually lost in connection with commercial fishing. Such work has now been undertaken on a limited scale by placing spawn takers on the fishing vessels operating in the offshore fisheries, to strip the mature eggs from the fish taken, fertilize, and return them immediately to the water. The work is considered of special value, since it deals with the conservation of vast quantities of eggs of the cod and haddock which have heretofore been annually destroyed.

BOOTHBAY HARBOR (ME.) STATION.

[E. E. HAHN, Superintendent.]

Fish-cultural work at this station during the year was addressed to the winter flounder and the pollock and resulted in an output of 841,235,000 and 11,906,000 of the respective species. The pollock fry were produced from eggs collected in the Gloucester fields and represent the first really successful attempt to make long-distance shipments of pollock eggs. Collection of flatfish eggs was commenced February 23 and continued to April 22. A total of 6,298 female brood fish were handled during the season and yielded 906,696,000 eggs. Though weather conditions favored the work, the spawning season ended earlier than usual, and because of this circumstance the take of brood fish was smaller than had been anticipated. On the other hand, the female fish taken were above the average in size and yielded a correspondingly large number of eggs. Some experiments in the rearing of the fry were conducted but without marked results.

A careful watch of the local fishing grounds where a limited number of boats engage in a spring fishery for cod and haddock was maintained with the view of obtaining eggs. The results were negative, however, as has been the case for several seasons, no fish in spawning condition being taken. Similar results followed a continuation of an effort to locate spawning areas of the alewife in the Damariscotta River and other points in the vicinity of Boothbay Harbor.

The steamer *Gannet* has been connected with the work of this station and has rendered valuable assistance in fish-cultural operations, particularly in the flatfish work, also in transporting men and supplies in connection with the repairs that have been made to the lobster pound at Pemaquid, Me.

GLOUCESTER (MASS.) STATION.

[C. G. CORLISS, Superintendent.]

In this field the output of pollock fry has for a number of years been larger than that of any other species propagated. With the general adoption of the gill net for taking pollock in the shore fishery and the prevailing high prices, this fish, which was formerly of minor importance, has come into high favor. During the calendar year 1920 more than 4,000,000 pounds of pollock, valued at \$118,502, were landed fresh at Gloucester, Mass., approximately 3,745,000 pounds of this amount having been taken in the shore fishery. In 1921, the pollock spawning season extended from November 15 to January 21, and the egg collections aggregated 650,850,000 as compared to 954,800,000 the preceding year. In the course of the fishing season there was a rather sharp decline in the market price of pollock, which resulted in the withdrawal of many boats from this line of work. The weather throughout the spawning period was exceptionally good, and to this fact the higher quality of the eggs obtained is attributed. Twenty-four million of the eggs were transferred to the Boothbay Harbor (Me.) station, and the remainder produced 443,160,000 fry, which were distributed on the pollock spawning grounds.

A rather unusual occurrence connected with the pollock work is the fact that the fish apparently sought new spawning grounds during the season. Heretofore practically all of the spawning fish have been taken in Massachusetts Bay, and all fish taken from spawning grounds to the eastward of Cape Ann have been barren of eggs. This year, however, large numbers of eggs were obtained from fish caught on the grounds lying from 20 to 30 miles eastward of Cape Ann.

The season's collection of cod eggs fell considerably below last year's established record collection of 570,704,000. Two reasons are ascribed for the falling off, (1) the comparatively small run of fish on the shore spawning grounds, and (2) the low market price for cod. Eggs were taken between January 15 and April 29, the total amounting to 210,040,000. Of these 151,530,000 were planted on the spawning grounds immediately after being fertilized, this method being resorted to at times during the spring months, when the low density of the sea water does not permit of making transfers to the hatchery. In addition to the local collections cod eggs to the number of 8,700,000 were transferred to Gloucester from the Woods Hole hatchery. The fry distribution from the station amounted to 50,900,000.

Propagation of the haddock at the Gloucester station was eminently successful and is represented by a record collection of eggs of that species. The causes contributing to this result were favorable weather, an abundance of fish on the spawning grounds throughout the season, and the comparatively high market price for haddock. The price was an important factor in attracting to this fishery a large number of fishermen who ordinarily follow the cod or other lines of fishing. The spawning period extended from January 22 to April 25, and 629,120,000 eggs were taken. Of these, 182,120,000 were deposited on the spawning grounds for the reason stated above.

Since the mild winter suggested the probability of an early spawning season for flatfish, nets were set as early as February 2 for the capture of a brood stock, but no fish were secured until March 14. During the first week of the season the take of adult fish was unusually large, giving promise of a fine egg collection. With the beginning of active commercial fishing, however, the collection of fish for propagation work fell off rapidly, and the season's operations resulted in obtaining only 154,740,000 eggs. From this stock 132,070,000 fry were hatched and distributed.

Because of the prominence the pole flounder has attained in the New England markets in recent years and the constantly increasing number of fishermen engaged in its capture, an investigation of the spawning habits of the fish was made with the view of undertaking its artificial propagation in the event that course seemed advisable. At the present time commercial fishing for the pole flounder begins in midwinter some 15 miles off Cape Ann. The fish appear to work slowly inshore, and by July fishing for them is in progress in the shoal waters of Ipswich Bay. The average daily catch per boat is from 8,000 to 12,000 pounds.

Large numbers of the fish were examined in April, but no ripe spawn was found until May 22. From that date until June 30, when the work was brought to a close, 19,410,000 eggs were taken,

fertilized, and planted on the spawning grounds. The eggs of the pole flounder are about one-twentieth of an inch in diameter, a liquid quart containing approximately 426,000. They are semi-buoyant and nonadhesive. It is probable that spawning continues throughout the summer months. It would appear that the species is worth the attention of fish culture, and that considerable numbers of eggs for artificial propagation are obtainable in the commercial fishery at comparatively small expense.

WOODS HOLE (MASS.) STATION.

[W. H. THOMAS, Superintendent.]

At the approach of the cod spawning season at this station negotiations were entered into with fishermen operating vessels equipped for carrying live fish to supply brood cod for the propagation work, but as only one suitable vessel was available the number of fish secured was smaller than was desirable. The first consignment of 485 fish was delivered on November 15. Five further consignments delivered between that date and December 6 brought the total brood stock up to 2,441 fish, all of which were placed in the spawning cistern. Stormy weather prevented any further deliveries. The fish were an exceptionally fine lot, a large percentage being females. For several seasons heretofore cod propagation at the Woods Hole station has been reduced to almost negligible proportions because of the very large percentage of barren fish among the brood stock. It is impossible to assign an entirely satisfactory reason for this condition, but it may have been due partly to the undersize of the fish and also to the fact that they were taken in places not usually frequented by spawning fish. The fish secured this season were of good size and were taken on fishing grounds located some distance offshore. The egg returns from them were very satisfactory, the total amounting to 214,702,000. Of this stock, 8,700,000 green eggs were transferred to the Gloucester station and 124,441,000 fry were hatched.

On account of more favorable weather conditions the results of the season's flatfish work were larger than those of the previous year, though the egg collections were not equal to that of the record year of 1918. Operations in local fields began on January 12 and resulted in a collection of 803,567,000 eggs. A very satisfactory increase in the number of fish obtained at Quisset Harbor is to be recorded. The collecting station at Wickford was opened March 18 and was in operation until March 28, when high-water temperatures made it impracticable to continue the work. The egg collections at this point amounted to 112,228,000, or less than half of last year's. From the total of 915,855,000 eggs obtained from all points fry to the number of 795,355,000 were hatched and deposited in local waters.

During March, 1920, the three-story frame building connected with the Woods Hole station, the first floor of which was occupied as a machine shop while the two upper stories furnished storage space for fish-cultural and scientific equipment, was destroyed by fire. A special appropriation of \$65,000 for rebuilding and replacing equipment was provided by Congress, becoming available June 5, 1920.

Advantage was taken of this opportunity in reconstruction to make certain changes in building and equipment that will add much to the

convenience and efficiency of the operations and also effect an economy. The new building, of fireproof construction, provides for a machine shop, boiler and pump room, garage, and ample storage space. The old boiler and pump room, of frame construction, constituting a further fire menace, has been removed. The new boiler space is adjacent to and connected with the coal shed by a covered passage, thus eliminating a long and expensive haul of coal from the storage to the boiler.

Another important change was the construction of a sand filter, with a capacity of 300 gallons of water per minute. The arrangements are such that the water from the cod-spawning cistern enters the filter by gravity. From the filter it is returned to the storage tanks by the pumps. "Make-up" water will be added each day in sufficient quantities to keep the supply in good condition. This will add to the efficiency of the fish-cultural work by eliminating from the hatchery the sediment that is carried in the water taken direct from the harbor and which has been particularly detrimental to the eggs under incubation during periods when the harbor water is agitated by high winds. The arrangement will be further effective in a saving of fuel, since it is found expedient to raise the temperature of the hatchery water supply from 8 to 10 degrees during the winter months. The new system will permit of the water that has been warmed being kept in circulation throughout the entire system. Modern heating apparatus, with automatic thermo controls and an electrically operated pump, for use during the summer when but comparatively small quantities of water are used, will effect a further saving in fuel consumption.

PROPAGATION OF BUFFALOFISH, ATCHAFALAYA (LA.) SUBSTATION.

[C. F. CULLER, in Charge.]

The propagation of buffalofish in the Atchafalaya River district of Louisiana is meeting with success, dependent to a large extent on the regulations recently established by the Louisiana Conservation Commission. Under existing arrangements no fisherman is allowed to operate nets during the spawning season without first securing from the State authorities a permit, which is revocable in the event that the eggs of all ripe fish taken are not delivered without charge to collecting agents of the bureau. It is considered that permission to fish during the closed season, with the right to retain the fish captured after stripping, is sufficient compensation for the eggs turned over to the bureau.

This work was inaugurated in the spring of 1918 to meet the large and increasing market demands for buffalofish, and while the water stages in the river during the spawning season are not uniformly favorable the experience gained has demonstrated that, with the local cooperative assistance at present afforded, there is no reason why hatching operations should not be continued on an extensive and profitable basis. Thus far the fishermen have willingly complied with the terms of the regulations, and the cooperation rendered by them has contributed largely to the success of the work.

In the season of 1921 the substation was opened on January 23 and, in order to free the hatchery water supply of the large amount of sediment contained in it, a filter was installed in the water-supply

line. No sand being available for the purpose, cinders were substituted, and to the presence of this material is attributed the loss of approximately 46,000,000 of the first eggs received. The removal of the cinders and the refilling of the filter with sand and gravel corrected the situation, though the output of the substation was considerably reduced.

The first eggs were taken on February 27, and during the spawning season, which ended on March 25, a total of 96,440,000 eggs were taken. Of these, 1,440,000 were planted on the spawning grounds after being fertilized and 38,600,000 fry were developed at the hatchery. The conditions were unusual, inasmuch as the Atchafalaya River was at a low stage until late in January, whereas a rise occurs in the late fall in more normal years, its effects continuing into the spring months. To this condition may be attributed the short season and the small numbers of fish on the customary spawning grounds. The water temperatures during the egg-collecting period ranged from 60 to 76° F. The incubation period was 10 days in a mean water temperature of 60°. The eye spots in the egg are visible to the unaided eye in from four to five days, and the fry have absorbed the umbilical sac in from four to five days after hatching.

Further counts and measurements to ascertain the correct number of eggs to a liquid quart were made and a standard of 120,000 was established as a result. Observations were made at several points to determine the percentage of fertilization that is attained in eggs deposited under natural conditions. The results varied from zero in certain places to as high as 40 per cent at others, with an average of 10 per cent at all points considered. Efforts were also made to secure information relative to the spawning of the paddlefish, but nothing of a reliable nature was gained.

Buffalofish propagation conducted on an experimental scale at Clarendon, Ark., has been permanently discontinued, it having been found that very few of the local fishermen are inclined to lend their cooperation.

PROPAGATION OF ANADROMOUS FISHES OF ATLANTIC COASTAL STREAMS.

Included under this head are the shad, glut herring, alewife, striped bass or rockfish, and the Atlantic salmon.

PROPAGATION OF SHAD, BRYANS POINT (MD.) AND EDENTON (N. C.) STATIONS.

The work addressed to the shad is conducted at only two hatcheries, Bryans Point, on the Potomac River in Maryland, and Edenton, on Albemarle Sound in North Carolina. It is interesting to note that the run of shad is being maintained in these regions, notwithstanding the failure to put into effect the greatly needed regulatory measures for which the bureau has worked. During the 12-year period from 1910 to 1921, both fiscal years inclusive, the Maryland hatchery distributed a total of 448,799,000 shad fry, an average annual output of 37,399,000. The total output of shad from the North Carolina hatchery during the same period amounted to

409,683,000, or an average annual output of 34,140,250. Practically all of these fry in each instance were distributed on local spawning grounds. In view of the conditions that exist in other shad streams where artificial propagation is not conducted, it seems but just to assume that the hatcheries have been a factor in maintaining the shad fisheries in their vicinity.

The bureau is frequently importuned by State officials and others to render assistance in restocking depleted shad streams by planting therein a portion of the output of its two hatcheries. In their efforts to obtain this assistance the illogical argument has been advanced that the shad hatcheries, being the property of the Federal Government and supported by public funds, should apportion their output in accordance with public demands and without regard to the source of supply. Were the bureau to be influenced by such reasoning it would result in dividing the comparatively small output of its two hatcheries among various States along the Atlantic seaboard. The numbers allotted in any instance would be negligible, and such a course would inevitably result disastrously to the fisheries in the waters in which hatchery operations are now conducted.

For many years the bureau followed the policy of making systematic plants of shad fry in the principal shad rivers and tributary streams along the Atlantic seaboard, but the results did not justify a continuance of such efforts, because the States concerned did little or nothing for the protection of the species, and with the rapid and constant increase in fishing operations and fishing devices the run constantly lessened. Finally, in order to maintain the dwindling supply in home waters the bureau found it necessary to discontinue shipments to outside points and return to the local spawning grounds the entire product of its shad hatcheries.

The status of the shad fisheries at the present time is precarious in the extreme, fully warranting the adoption of drastic measures if they are to be saved from total and early extinction. In spite of the discouraging situation, however, the States most nearly concerned have thus far appeared loath to take any decidedly aggressive action toward safeguarding or increasing the run.

While the falling off of the shad run in many Atlantic coastal rivers and their total disappearance in others are due to several causes, the chief factor involved would seem to be a total lack of protection during the spawning season. As a result of the extensive fishing operations near the mouths of such streams and in the salt and brackish waters below very few shad are able to reach their spawning grounds. The considerable amount of trade waste entering the streams has also had a deleterious effect.

The collection of shad eggs in the Potomac, at the Bryans Point (Md.) station, fell considerably below that of a normal season, amounting to only 15,620,000. During February and March the weather was unusually mild, with high water temperatures, the maximum in March being 64° F., with a mean temperature of 52° F. As a result, spawning shad were taken unusually early, and 316,000 eggs were secured during that month. Weather conditions in April were a reversal of those in March, with equally unfavorable results to the work, and the season was brought to an early close on May 9. Approximately 1,110,000 of the eggs secured were sent to central

station for an exhibit, and the resulting fry were returned to the Potomac River. The eggs retained for incubation at the hatchery produced 13,639,175 fry, all of which were deposited on local spawning grounds.

The conditions during the season were especially favorable to pound-net operations. The high water temperatures in March appeared to cause the shad in their upstream migration to leave the deep-water channels, which are unobstructed by nets, and seek the shallower water of the flats, thus coming in contact with the pound nets set to intercept them. In 1915 similar conditions prevailed, and that season and the one under discussion represent the only marked variations in the collections of shad eggs at this station in a long period of years.

Another factor bearing on the shad work in the Potomac River is the apparent increasing indifference of certain fishermen to the necessity for cooperating with the bureau by saving for propagation the eggs from the spawning fish taken by them. Most of the fishermen render this service willingly, realizing its value to them and to their industry, but the high prices paid for shad in recent years have evidently created among a certain class of fishermen a feeling that the only important consideration is to get the largest number of shad to market in the shortest possible time. This attitude has undoubtedly resulted in the loss of a very considerable number of eggs, and if it continues it may become advisable to invoke the aid of the Maryland and Virginia authorities. Since the shad fishermen are licensed by the State in which they operate, it would seem that a regulation might be put into effect that would require all fishermen taking shad on the spawning grounds within certain areas and in working distance of the hatchery to assist employees of the bureau in conserving the ripe eggs under penalty of a revoked license for failure to comply.

The first shad eggs for the Edenton (N. C.) hatchery were secured on March 28, and on May 5 the season ended with a total collection of 21,710,000 eggs. As at Bryans Point, climatic conditions were unfavorable for the best results, the fluctuating water temperatures being particularly annoying. A considerable reduction in the expense of collecting eggs was effected during the season by closer cooperative relations with the fishermen, a situation that the bureau has constantly endeavored to foster. One of the difficulties in obtaining shad eggs in this region is the large number of pound nets used. As such nets are lifted at infrequent intervals, the eggs of fish taken in them are seldom fit for incubation. Eggs of the shad appear to be at their best when taken from fish caught between sundown and midnight. For this reason gill nets, which are set on the ebb tide and lifted at half-hour intervals, constitute the most dependable source of egg supply for the Edenton hatchery.

The Edenton station also propagates pond fishes, mention of which is made on page 63.

PROPAGATION OF GLUT HERRING, EDENTON (N. C.) STATION.

The propagation of glut herring was taken up last season for the first time at Edenton, and the results obtained may warrant a continuance of the work. Some opposition was made by local fisher-

men on the ground that the stripping of the fish reduced their market value, an objection which is not altogether well founded. While it is true that the appearance of the female may be affected by the stripping process, the roe at spawning time has no market value. The spawning season of this species coincides with that of the shad, and for that reason the egg collections were limited, the hatching capacity permitting of a total collection of 56,130,000.

PROPAGATION OF ALEWIFE, BOOTHBAY HARBOR (ME.) STATION.

For the past two seasons attempts have been made to secure eggs of the alewife for artificial propagation at the Boothbay Harbor (Me.) station. The Damariscotta River supports a run of the species, and there is a fishery of some importance at Damariscotta Mills. An examination of the fish taken at this fishery in tide-water very soon disclosed that no fish with mature spawn were obtainable from this source. The efforts made to hold the fish in an inclosure, awaiting the maturity of the eggs, were not successful, and attempts to secure eggs from the fish after their entrance into fresh-water ponds above the falls were equally unsuccessful. Seines, pound nets, and fyke nets were employed at Damariscotta Mills and at West Boothbay Harbor in ponds where the alewife is known to spawn, but the results were negative in every instance in so far as they pertained to eggs for propagation, though considerable numbers of fish with immature eggs and also of spent fish were taken. No satisfactory explanation of this unusual situation is at hand, since alewives in spawning condition are taken in various forms of nets at other points.

PROPAGATION OF STRIPED BASS, WELDON (N. C.) SUBSTATION.

The bureau propagates the striped bass or rockfish at a single substation, located on the Roanoke River at Weldon, N. C., where a yearly average of about 12,500,000 fry is hatched and returned to the spawning grounds in the river. The work is greatly handicapped by the floods usually encountered and also by the difficulty experienced in securing ripe fish of the two sexes at the same time. During the height of the run this latter condition is less pronounced than it is earlier or later in the season. Contrasted with the output of some of the commercial species, the work at this hatchery is not large, but it is showing a steady and gratifying increase, as is evidenced by a comparison of the results of the past 10 years. The production of striped bass fry at Weldon rose from 5,256,000 in 1912 to 20,184,000 in 1921, an increase of nearly 400 per cent.

PROPAGATION OF ATLANTIC SALMON, CRAIG BROOK (ME.) STATION.

[J. D. DE ROCHER, Superintendent.]

For many years it has been the practice of the bureau to purchase in May and June practically all the salmon captured by the Penobscot River fishermen, estimating the average weight at 12½ pounds, and paying the prevailing market prices for them, together with a bonus of 60 cents per fish for careful handling. The fish have been held in a large lake or inclosure until their eggs were mature,

and after having been stripped they have been released in the river. Operations along these lines have resulted in the purchase of almost the entire catch and paying for the fish at a seemingly exorbitant price, this amounting in effect to the maintenance of the run for the sole purpose of furnishing employment to a few river fishermen.

After thoroughly canvassing the situation the bureau recently decided to curtail its expenditures in this direction, with the view of ascertaining if equally good results could not be brought about by less expensive methods. Taking all related facts into consideration, it would seem that the State of Maine should interest itself in providing efficient fishways over the dams which at present obstruct the passage of the salmon to their natural spawning grounds.

At the beginning of the fiscal year there were on hand 316 brood salmon, obtained by purchase from local fishermen in June. At the spawning season in October these fish yielded 911,720 eggs, from which 821,240 fry were hatched. On March 12, 1921, 600,000 eggs of this species were received from the New Brunswick hatcheries of the Canadian Government in exchange for eggs of the brook, rainbow, and blackspotted trouts. These were successfully incubated, producing 565,760 fry, all of which entered into the general distributions in Maine waters.

Propagation of Fishes of Interior Waters.

The serious inroads that have been made in the public waters of the interior as a result of the extensive and rapidly increasing use of the touring automobile are making it exceedingly difficult to maintain the fish supply in such waters. Recognizing the necessity for heavier stocking of their waters, many of the States have called upon the bureau for assistance, which, in view of its greatly overtaxed resources, it has not always been possible to extend. One of the greatest demands is for brook trout. The bureau does not produce its brook-trout eggs, but of necessity relies upon commercial fish-culturists for a large portion of its supply. In many instances such eggs can not be considered as more than a by-product of the commercial plants. They are, as a rule, taken from 2-year-old and 3-year-old fish and for that reason do not have the stamina that might be expected from the progeny of older fish. In view of this situation, Congress has been asked for sufficient funds to establish a plant for the production of the brook-trout eggs needed to fill the bureau's hatcheries. After placing it on an operative basis such a plant could be made to produce eggs of superior quality in numbers sufficient to meet the bureau's requirements and at a smaller cost than is now involved in the purchase of a poor grade of eggs.

The demand for smallmouth black bass can not be met by the hatcheries, the principal handicaps in the work with this species being unfavorable weather and insufficient pond space. Means for increasing the production of bass and other so-called warm-water fishes are again mentioned as being one of the most important requirements of the service. During a long period of time the output of such fishes has not kept pace with the demand, and to meet the deficiency the bureau has found it necessary to utilize for general

distribution a small percentage of the fishes rescued from the Mississippi River overflows. In recent years the demand for bass has increased, but funds have not been provided for increasing the production of the species at the fish-cultural stations. This has resulted in a tendency to draw more heavily on the rescue work to meet the demands, until the number of bass so diverted in the fiscal year 1921 amounted to approximately 43 per cent of the total number rescued. Any increased diversion of bass from this source is not advisable, and unless other means are found for an increased production of the fish-cultural stations a large number of applications must of necessity remain unhonored.

Of interest in connection with the fish-cultural work is the development in recent years of fish and game protective associations in practically all parts of the country. Composed as they are of the leading citizens of the communities in which they reside, their influence for the protection and conservation of the natural resources is of great benefit. Such organizations endeavor to obtain the services of men experienced in stocking local streams with fish life, and in many instances they maintain ponds at their own expense for the purpose of rearing young fish obtained from State or Federal hatcheries to a larger size than would be otherwise possible before planting them in public waters. The intelligent cooperation resulting from this movement is marked and is worthy of encouragement. Another favorable influence exerted by organizations of this character is an increased respect on the part of the general public for the State fish and game laws. It is the policy of nearly all such organizations to favor better protective laws, to demand of their members a strict observance thereof, and to urge the same line of conduct on all others with whom they come in contact.

Among the more important species propagated for the stocking of interior waters are the catfish; rainbow, blackspotted, and brook trout; crappies; largemouth and smallmouth black bass; rock bass; and sunfish. The results accomplished with these species by the various stations during the fiscal year 1921 are reviewed in the following discussion. Data concerning the spawning seasons are given on pages 73 and 74, and a tabulation of the amount and cost of fish food used occurs on page 76.

NEW ENGLAND SALMON AND TROUT STATIONS.

BERKSHIRE (MASS.) STATION.

[WILLIAM A. CASLER, Superintendent.]

Fish-cultural work at this station, which is located near the town of Hartsville, Mass., was confined to operations with the brook and rainbow trout. Between October 20 and November 10 brook-trout eggs to the number of 133,500 were collected from brood fish in the station ponds, and two lots of eggs, aggregating 322,500, were acquired by purchase from commercial hatcheries. As the station fish were old and somewhat imperfect through interbreeding, the quality of their eggs was poor and heavy losses resulted, both during the incubation period and at the time the fry were ready to take food. A heavy loss was also sustained on one lot of the commercial eggs

from the disease known as "bluesac." In each case, however, after culling out the defective stock no further trouble was experienced; and the distributions of young fish from the three lots of eggs comprised 296,825 healthy No. 1 and 2 fingerlings, with 34,000 fingerlings on hand at the close of the year.

From two lots of rainbow-trout eggs—one of 50,000 transferred from the White Sulphur Springs hatchery and another of 6,920 taken from the station fish—43,900 thrifty fingerlings were produced, of which 2,000 remained on hand at the end of the year. The spawning season of the rainbow trout at this station extended from December 22 to January 20.

CRAIG BROOK (ME.) STATION.

[J. D. DE ROCHEZ, Superintendent.]

In addition to the propagation of the Atlantic salmon, for which purpose this station was primarily established, it has an annual output of brook trout from eggs purchased of commercial fish-culturists. The distribution of this species for the fiscal year 1921 amounted to 1,085,000 fry and 23,625 fingerling fish. The year's distributions also included landlocked salmon fry and fingerlings to the number of 43,545, these fish being the product of eggs transferred from Grand Lake Stream. A detailed account of the work with the Atlantic salmon is contained in the section devoted to the anadromous fishes, page 45.

Having an abundant water supply of excellent quality, this station possesses opportunities for development as a trout-rearing center. At comparatively small cost its capacity may be increased to the point where it will alone adequately meet the requirements of that section of the country.

GREEN LAKE (ME.) STATION AND SUBSTATION.

[JOHN A. STORY, Superintendent.]

Perhaps the most important part of the work of this station is the propagation of the landlocked salmon. Operations addressed to this species are conducted at the main station, a substation at Grand Lake Stream, and an egg-collecting station on Fish River Lakes, the work at the latter point being done on a cooperative basis with the Maine Commission of Inland Fisheries and Game. At Fish River Lakes egg collections were made from Cross, Eagle, and Square Lakes Thoroughfares, aggregating 525,000. These were all delivered at the State hatchery for eyeing. Under the agreement 250,000 of them were reserved for planting in parent waters, while the remainder were divided equally between the bureau and the State hatcheries after being eyed. The lakes were at high level prior to the spawning season, with but little rain during that period. Under these conditions there was but little and a constantly decreasing current over the usual spawning areas. This is thought to have been a factor in the reduced egg collections, though whether or not it was the most important one it is hardly possible to say. A total of 336 male and 260 female fish were handled during the season, the first being taken on October 24 and the last on November 9.

The number of landlocked salmon eggs taken from Green Lake represents an average season. Pound nets were set at the mouth of Great Brook as usual, and 87 female and 49 male fish were taken, the first fish entering the trap on October 14 and the last on November 19. Eggs to the number of 220,300 were secured, of which 70,000 were shipped to applicants. From the remainder 122,120 fry were hatched and distributed.

Of the 317,200 eggs obtained at Grand Lake Stream 115,000 were shipped to other points and 184,400 were retained for parent waters. To the unseasonably warm weather, which continued through the late fall, and the consequent high-water temperatures the delayed and prolonged run of spawning salmon is attributed. Spawning fish were still being taken in small numbers daily, when a sudden temperature change, with danger from ice, made it necessary to discontinue operations. The adult fish taken this season were of a larger average size than is usual at this point. Several specimens weighing 6 and 7 pounds were taken, yielding an average of 1,600 eggs per fish. During July and August 79,000 fingerling salmon carried over from the previous year were liberated in Grand and Dobsis Lakes.

The work addressed to the propagation of smelt met with a fair degree of success. From the 8,000,000 eggs obtained 7,000,000 fry were hatched and liberated in local waters and 600,000 eyed eggs were shipped to applicants. Practically all of the eggs were obtained this season from natural spawning, the adult fish being confined in troughs until this function was performed, after which they were liberated and the eggs transferred to hatching jars. Comparative tests of this method of obtaining eggs as against artificial stripping seems to prove the superiority of the former method. Of 150,000 eggs taken by artificial stripping only about 15 per cent produced fry, while the percentage of hatch obtained from natural spawning was 95. It was noted, however, that the best results were obtained from fish that were about ready to spawn when taken. When held in confinement for more than 36 hours prior to spawning, eggs of a poor quality resulted. In one instance a trough in which approximately 500,000 eggs had been deposited was left undisturbed for observation after the removal of the adult fish. On the fourth day the eggs showed the effects of smothering, this condition, which is well known to fish-culturists, being brought about by improper aeration of the water. The dam at the outlet end of the trough was raised, thus subjecting the eggs to a more rapid flow of water and relieving the dangerous symptoms. These eggs completed incubation in 14 days, with a mean water temperature of 55.5° F., as against 20 to 27 days for the eggs incubated in Downing jars, with a mean water temperature of 46°.

In addition to the species already mentioned, brook-trout eggs to the number of 788,860 acquired by purchase from commercial dealers and 50,000 rainbow-trout eggs transferred from the bureau's Virginia station were received during the year. Fifty thousand of the brook-trout eggs were reshipped to the Grand Lake Stream substation. From the eggs of that species retained at Green Lake 608,050 fry were distributed. The rainbow-trout eggs underwent a rather heavy loss during incubation and produced only 26,000 fry.

The distributions from the Grand Lake substation consisted of 47,880 brook-trout fry, 115,000 eyed eggs of the landlocked salmon, 55,000 landlocked-salmon fry, and 79,100 landlocked-salmon fingerlings, with approximately 74,000 fingerlings of that species on hand at the end of the year.

NASHUA (N. H.) STATION.

[WALDO F. HUBBARD, Superintendent.]

The work at this station was concerned with the brook and rainbow trouts, pike perch, and smallmouth black bass. A few brook-trout eggs were obtained from brood fish at the station, but most of the eggs of this species were acquired by purchase. The rainbow eggs, with the exception of 16,638 taken from fish in the hatchery ponds, were transferred from the Wytheville (Va.) station, and the pike-perch operations consisted in the incubation of 2,000,000 eyed eggs shipped from Swanton, Vt. During the spawning season of the smallmouth black bass in Lake Sunapee, extending from June 2 to June 17, collections of fry of that species to the number of 31,700 were made and shipped to applicants. The work with the various species was conducted without unusual incident, and the output of fish for distribution is shown in the table on page 12.

ST. JOHNSBURY (VT.) STATION.

[A. H. DINSMORE, Superintendent.]

From this station as a center the usual field stations for the collection of brook-trout eggs were operated at Lake Mitchell and Darling Pond. Largely because of climatic conditions, the results of the work at both points were rather unsatisfactory. The egg collections amounted to 214,148 and 411,777, respectively, all of which were of the usual high quality.

During the summer of 1920 an investigation was made of the fish-cultural possibilities existing at points on the Big Margalloway and Little Margalloway Rivers and Parmacheene Lake, in northern Maine. As the field gave promise of satisfactory returns, a tentative plan was formulated for undertaking work in cooperation with the Northern Oxford Guides Association. The first eggs were taken October 13, and the collections, which extended to October 27, aggregated 300,000. As the main objects of the work were to build up the supply of trout in the local waters and to encourage the local organization in their fish-cultural activities, the bureau claimed only 50,000 of the eggs secured. The others were successfully incubated in the log hatchery put up by the association, and the resulting fry were planted, with but slight loss, in local waters. While the work was not particularly successful from a fish-cultural standpoint, the information gained will be useful in connection with any future work that may be attempted in that field.

At Lake Dunmore, Vt., a new field station was established for the collection of lake-trout eggs and was operated jointly by Federal and State employees. Eggs to the number of 130,000 were collected and sent to the Holden hatchery, another subsidiary of the St. Johnsbury station, to be eyed. After reaching the eyed stage half of them were turned over to the State fisheries authorities.

In accordance with past custom a considerable number of brook-trout eggs was purchased, and as usual they were greatly inferior to the eggs obtained from wild stock. Such purchases amounted to 877,800, and 56,000 eggs in addition were turned over to St. Johnsbury station by a Massachusetts dealer, with the understanding that half the resulting fry were to be placed at his disposal for sale to persons desiring fish for stocking private waters, the other half to be the property of the bureau. Two shipments of steelhead-salmon eggs, aggregating 58,000, were received from one of the Puget Sound (Wash.) stations, and a consignment of 25,000 landlocked-salmon eggs was forwarded from the Grand Lake Stream (Me.) hatchery.

Following the custom of past years, collections of smallmouth black bass fry were undertaken at Lake Tarleton, and though started some 10 days earlier than ever before they did not precede the unusually early spawning of the bass. High winds interfered with the work, making difficult the placing of screens and the dipping of the fish, and in some instances the screens were destroyed. Approximately 54,000 fry were obtained from this source and placed in ponds at the St. Johnsbury station for later distribution. This work at Lake Tarleton enables the bureau to secure limited numbers of bass for distribution in the Vermont field and at the same time assists in keeping down their numbers in the lake, where they are considered objectionable.

At the Holden substation approximately 350,000 brook-trout eggs were received, some from the field stations and some from commercial hatcheries, and the distributions of fry and fingerling fish from this lot amounted to 173,700, with 47,380 fingerlings on hand at the end of the year. The rather serious losses made evident by these figures are attributed mainly to an accident occurring on April 15, when the spring water supply to the hatchery was cut off. A more extensive system of aeration had been installed to overcome the losses occurring in recent years through defective aeration of the water. The new system promises good results, but because of this accident the evidence in its favor can not yet be considered conclusive. This substation also handled and distributed the product of approximately 145,000 lake-trout eggs collected at Lake Dunmore, Vt., 25,000 of the same species transferred from the Charlevoix (Mich.) field, and 50,000 rainbow-trout eggs received from the West Virginia hatchery of the bureau.

Work looking to the development of the York Pond (N. H.) site as a station for the production of brook-trout eggs was carried forward as expeditiously as the limited funds available for the purpose would allow. During the summer the small bottom west of the pond and the extensive flat below it were cleared and a small log cabin to house the employees was constructed. Officers of the Forest Service have rendered valuable aid in the work of developing this station. Through their efforts the camp has been provided with telephone connections, and they are planning for the construction of a wagon road to the site. They have also rendered assistance in running levels, with the view of turning the flow of one or more of the adjacent brooks into the pond system.

ROCKY MOUNTAIN TROUT STATIONS.

BOZEMAN (MONT.) STATION AND SUBSTATIONS.

[W. T. THOMPSON, Superintendent.]

Although the cold, stormy weather of winter was unduly protracted, interfering with fish-cultural work into the late spring months, a satisfactory season is to be recorded in this field. With Bozeman station as headquarters an auxiliary station is operated at Meadow Creek, in the Madison Valley, and substations in the Glacier National Park and the Yellowstone Park.

BOZEMAN (MONT.) STATION.

Fish-cultural work at the Bozeman station was confined to the incubation of eggs transferred from other points, these transfers amounting to 1,357,200 rainbow-trout eggs from Meadow Creek, 1,236,400 blackspotted-trout eggs from Yellowstone Park, and brook-trout eggs from the Springville and Leadville stations in the numbers of 350,000 and 782,000, respectively. Part of the rainbow-trout eggs were shipped to applicants and other stations; the remainder were hatched and distributed as fry and fingerlings to fill the demands for them in Montana, Wyoming, Idaho, Washington, and Oregon. Approximately 800,000 fry of the rainbow trout and black-spotted trout remained on hand at the close of the fiscal year.

MEADOW CREEK (MONT.) AUXILIARY STATION.

The Meadow Creek egg-collecting or auxiliary station was opened on April 9. The weather throughout the spring was cold and stormy, and there was no clearly defined run of fish, as is the case under more favorable conditions. The first rainbow trout appeared at the rack early in April, and the run continued at intervals up to June 10, during which period 2,273,000 eggs were taken. Of this number 1,357,200 were sent to the Bozeman station. The eggs taken during the latter half of the spawning season were of poorer quality than usual, probably because of the turbid water, which was materially affected by the storm conditions. The results of hatching were therefore disappointing, and of those retained for stocking home waters only 300,000 fry were realized. Near the close of the fiscal year 500,000 blackspotted-trout eggs were received at the Meadow Creek hatchery from the State hatchery at Anaconda, and these, with 30,000 rainbow-trout fry, were on hand June 30.

Mixed in with the rainbow-trout run were a limited number of grayling, though not sufficient to warrant spawn taking. The fish appeared to have been driven into the lake by the soft ice in the stream shortly after their appearance at the racks, the grayling evidently being very susceptible to influences of this kind. In recent years grayling have deserted the Meadow Creek spawning grounds, to which they formerly ascended in considerable numbers every spring. Whether or not the successful establishment of the rainbow trout therein is responsible for the abandonment of the stream by the grayling is conjectural, but the present spawning grounds of the fish in the region are unknown, though several attempts have been made to locate them.

YELLOWSTONE PARK (WYO.) SUBSTATION.

The spawning season of the blackspotted trout in the Yellowstone Park involves portions of two fiscal years. At the beginning of the fiscal year 1921 there were on hand in the hatchery 850,000 eggs which had been collected in June, and this number, added to the total obtained in July, gave an aggregate collection of 6,430,400 for the season. During the spring of 1921 the season was late, as at the Meadow Creek auxiliary station, and ice was still in Yellowstone Lake at the arrival of the spawning crews on June 10. The first eggs were taken at Fish Lake, near Soda Butte, on June 19, and at the close of the fiscal year the total egg collection numbered 1,747,500, of which 829,600 were obtained from Fish Lake and the remainder at different points on Yellowstone Lake. All eggs taken during the year were of excellent quality. The usual limited numbers were assigned to various State fish and game commissions, and smaller numbers were diverted for stocking the waters of the Glacier National Park. The remaining eggs were incubated at the lake hatchery, and fry to the number of 2,012,400 were distributed in Yellowstone Park waters, the park superintendent cooperating in the distribution.

GLACIER PARK (MONT.) SUBSTATION.

From the Glacier Park hatchery, which was in operation for a period extending from June 13 to September 17, 1921, there were distributed in park waters 2,035,000 fry and fingerling grayling, brook, rainbow, and blackspotted trout, with approximately 445,000 grayling and rainbow-trout fry on hand at the close of the fiscal year. The rainbow trout were derived from the Madison Valley egg collections and the blackspotted trout from the Yellowstone Park. For the grayling and the brook trout the bureau is indebted to the Montana Fish and Game Commission, and grateful acknowledgment of this cooperative assistance is hereby made. As in the Yellowstone Park distributions, officers of the national park service rendered valuable assistance in transporting the fish to suitable points for planting.

LEADVILLE (COLO.) STATION.

[CHARLES B. GRATER, Superintendent.]

The output of fry and fingerling fish from this station was smaller than usual because of certain conditions affecting the egg collections at two important sources. Low water at Turquoise Lake exposed the customary spawning beds of the trout, and attempts to take the fish by seines and fyke nets at other probable spawning points were not altogether successful. Similar conditions existed at Engelbrecht Lake, where further difficulties were experienced also in the matter of transportation. The aggregate total of brook-trout eggs obtained from the collecting fields occupied was 4,305,400. This station also handled 1,209,000 blackspotted-trout eggs transferred from the Yellowstone Park field, 130,000 rainbow-trout eggs from the stations in Wyoming and Utah, and 25,000 lake-trout eggs shipped from Michigan.

The Leadville station has for a number of years been able to successfully operate field stations at a number of privately owned lakes

and reservoirs, obtaining from them considerable numbers of brook-trout eggs for distribution in the form of fry and fingerling fish to applicants throughout Colorado and New Mexico and at the same time maintain unimpaired the original sources of supply. In recent years this work has suffered from the frequent labor changes occasioned by the low rate of compensation offered, and in certain instances the lake owners have refused to permit the continuance of fish-cultural work under the direction of the inexperienced men whom the bureau has been forced to place in charge. The time is at hand when a more definite policy with reference to this field of operations will have to be adopted if the work is not to seriously deteriorate.

SARATOGA (WYO.) STATION.

[O. N. BALDWIN, Superintendent.]

As has been mentioned in several previous reports, this field remains practically undeveloped because of lack of funds. Every year the station employees, at the expenditure of much time and labor, secure limited numbers of eggs at field stations where, with proper equipment and means for eying eggs intended for transfer and for the complete incubation of those needed for the maintenance of the local run of fish, the egg collections might be very greatly increased, the loss of eggs incident to their transfer in the green state obviated, operating expenses reduced, and the general efficiency of the work greatly improved. During the spring of 1921, with the primitive means available, the Sage Creek collecting field yielded 1,185,295 rainbow-trout eggs, Lost Creek, 982,185, and Canyon Creek—occupied for the first time—351,850, a total of 2,519,330. The station brood stock also produced 140,000 eyed eggs of this species.

Brook-trout eggs to the number of 1,132,400 were handled during the year. Of these 134,000 were taken from the station brood stock, 448,000 were received from Springville (Utah) station, and the remainder were taken at a new and promising field station located at Big Creek Lake, in North Park, Colo. This field is about 100 miles from the Saratoga station, well up on the Continental Divide. Incubation of the brook-trout eggs was completed a full month earlier than usual, with the result that most of the fry were taking food early in the winter.

Incidental to the other fish-cultural work, there are taken each season small numbers of Loch Leven-trout eggs, this species appearing to thrive in the streams of the region. With the more complete development of fields contiguous to the station it is probable that very successful work can be accomplished with the Loch Leven. Besides the species already mentioned, 200,000 blackspotted-trout eggs were received from Yellowstone Park collections and were incubated with a loss of only 6,000. The resulting fry and fingerlings entered into the general distribution. With improved roads and better transportation facilities there is reason to believe that the blackspotted trout will also eventually bear a conspicuous part in the operations of the Saratoga station. There remained on hand at the close of the year upward of 1,000,000 eggs, fry, and fingerling fish.

SPEARFISH (S. DAK.) STATION.

[D. C. BOOTH, Superintendent.]

There was a decrease in the output of this station during the fiscal year 1921 as compared with previous years, this condition resulting from the very limited water supply available. For a number of years the spring that has furnished the station with water has been decreasing in volume, until during the season of 1920 its flow did not exceed 25 gallons per minute. Quite opportunely, the city of Spearfish found it necessary to augment the city supply by constructing a new reservoir, and the bureau was able to effect an arrangement whereby it obtains the surplus water for its fish-cultural work. The expense involved in installing the new system made it necessary to greatly curtail all other expenditures during the year.

From the brood fish on hand 222,500 brook-trout eggs, 37,600 Loch Leven-trout eggs, and 79,000 rainbow-trout eggs were obtained. These collections were supplemented by the transfer of 150,000 rainbow-trout eggs from the Bozeman and Springville stations and 200,000 of that species from a commercial fish-culturist in Pennsylvania in exchange for an equal number of brook-trout eggs furnished from the bureau's Leadville station. Some 46,000 green brook-trout eggs were purchased from a local source, and 25,000 lake-trout eggs were received from the Duluth station. The fry and fingerlings resulting from all of this stock entered into the general distributions.

SPRINGVILLE (UTAH) STATION AND SUBSTATION.

[CLAUDIUS WALLICH, Superintendent.]

Fish-cultural work in this field during the year resulted in the distribution to applicants or in local waters from which egg collections were made of 463,600 No. 2 to No. 5 fingerling brook, black-spotted, and rainbow trouts, 250,000 eyed rainbow-trout eggs, 2,000 fingerling catfish, and 600,000 fry of the Bonneville whitefish from the Paris (Idaho) substation. In addition to the above approximately 700,000 fry and fingerlings of the various species of trout handled remained on hand at the close of the year and a total of 1,202,000 eyed brook-trout eggs were shipped, being consigned to the Bozeman, Saratoga, Spearfish, and Clackamas stations. These eggs do not enter into the records as an output of the Springville station.

Eggs to the number of 51,400 were obtained from the brood stock of brook trout at their first spawning. Because of inadequate facilities for handling the spawning fish there was a loss of eggs from natural spawning. The eggs taken were of a quality equal to that from wild fish. Spawning continued throughout the month of December. The brood stock of blackspotted trout yielded 107,800 eggs, the spawning season extending from March 20 to May 20. An overflow of muddy water through the pond system during the spawning season interfered with the most efficient conduct of the spawning work, hence the quality of the eggs was somewhat impaired. Spawning of the rainbow trout continued from December 30 to March 19, during which period 179,000 eggs were taken. In contrast to the brook trout the rainbows have continued in a healthy and

growing condition and successful results from the brood stock of that species are anticipated.

From the collecting stations located on Fish Lake, which are operating jointly by the bureau and the State of Utah, 1,901,400 brook-trout eggs and 1,734,800 rainbow-trout eggs were obtained as the bureau's share of the work. Employees of the bureau occupied the station at Twin Creeks from October 30 to November 14, after which the field was left to employees of the State. It is encouraging to note that the run of brook trout at this point has increased since the bureau's operations were undertaken, and it has been reported from reliable sources that a noticeable increase in the average size of the fish has occurred during the past two seasons, though this has not been verified by actual measurements or weight. The abundance of immature fish in the creek and along the shores of the lake appears to be a further indication of the success of the liberal planting of large-sized fingerlings.

During the course of the brook-trout egg collections it was noted that the adult rainbow trout were dying in considerable numbers, a condition that had existed for several months from information brought out on inquiry. The cause of the mortality could not be ascertained. The rainbow-trout spawning season at Twin Creeks occurred between May 1 and June 4, and at this time there was no indication of the mortality noticed in the previous fall.

There are several promising opportunities for extending the trout work of this station, among which may be mentioned the Kayune Reservoir, which is the property of the U. S. Fuel Co. This reservoir has been offered to the bureau exclusively for fish-cultural work, and the reports received from the plants of brook trout and rainbow trout made in it are most encouraging. There are very good prospects for early railroad communication with the Strawberry Reservoir, of the Reclamation Service, which is at present inaccessible during the spawning season of the rainbow trout. A recent investigation of Jorgensen Creek, a tributary of Fish Lake, about 4 miles from the present camp on Twin Creeks, indicates that a field station might profitably be established at that point. At the time the place was visited 46 large fish which had been beheaded by coyotes were noted.

The substation established for the propagation of the Bear Lake whitefish at Paris, Idaho, was opened on November 22 and operated until April 10. The usual difficulties encountered during the egg-collecting season—severe cold, violent winds, and snowstorms—prevailed without abatement. Eggs to the number of 1,056,000 were taken, from which 600,000 fry were hatched and planted, 500,000 being deposited on the spawning grounds in Bear Lake and 100,000 in Utah Lake.

COMBINATION TROUT AND POND FISH-CULTURAL STATIONS.

The stations possessing the greatest attractions for the general public are, perhaps, those located in sections of the country where the natural conditions make it possible to propagate both the Salmonidæ and the pond fishes. At such stations a brood stock of the

various species handled is maintained at all times and work of a strictly fish-cultural nature is under way throughout the year, whereas the fish-cultural work at certain of the hatcheries, especially those handling the commercial species, is seasonal in its character. The "combination" stations operated by the bureau are located at Erwin, Tenn.; Manchester, Iowa; Neosho, Mo.; White Sulphur Springs, W. Va.; and Wytheville, Va. Following is the aggregate output, by species, of this group of stations for 1921:

Brook trout -----	1, 064, 950	Smallmouth black bass----	112, 591
Crappie-----	14, 332	Sunfish -----	62, 355
Largemouth black bass---	121, 978	Yellow perch-----	58
Pike perch-----	500, 000		
Rainbow trout-----	2, 583, 244	Total -----	5, 154, 893
Rock bass-----	95, 385		

ERWIN (TENN.) STATION.

[A. G. KEESECKER, Superintendent.]

The aggregate output of this station shows an increase of about 30 per cent over that of the previous year. The spawning season of the rainbow trout began on November 8 and continued to January 27, the total egg collection amounting to 936,000, of which 822,000 were eyed. With the exception of 55,000 eyed eggs supplied to the State hatchery at Elkmont, Tenn., the entire lot was incubated in the Erwin hatchery. The losses were merely nominal, and the output of this species for the year amounted to 755,100, this number including 59,926 fingerlings derived from eggs transferred from the Neosho (Mo.) station. As an addition to the brood stock 10,000 steelhead eggs transferred from the Birdview (Wash.) station were incubated, producing 9,300 fry. The year's work with the rainbow trout indicates a very satisfactory improvement, both with regard to the productivity of the brood fish and the quality of the eggs secured. No brood stock of brook trout is maintained at this station, all eggs of that species handled being acquired by purchase from commercial dealers. During the year the 439,300 eggs thus acquired resulted in an output of 300,435 fingerlings.

The spawning season of the smallmouth black bass began on April 13 and continued to May 28. Twelve nests were occupied, and 10 of them were productive, though the percentage of fry hatched in each nest was small. The distribution of this species amounted to 5,165 fingerlings, and it was estimated that upward of 3,000 were on hand at the close of the year. The outcome of the operations with the largemouth black bass was better, 65,980 of these being available for distribution, with approximately 10,000 on hand at the end of June. During the spawning period, extending from April 13 to June 1, the warm weather during the spring was followed by colder weather, and this was an important factor in reducing the output of both species of black bass. The year's distribution also included 17,200 rock bass, 400 strawberry bass, and 20,350 sunfish, all fingerlings.

MANCHESTER (IOWA) STATION.

[FRANK E. HARE, Superintendent.]

The output of this station consists of 125,500 eyed eggs of the rainbow trout and 678,585 fry and fingerling fish of the different species propagated. The rainbow-trout brood stock did not yield an altogether satisfactory return, there being only 378,600 eggs taken. With the maturity of plans now being formulated a very decided improvement in this direction is confidently expected. During the spring 25,000 eggs taken from wild rainbow trout were transferred to Manchester from the bureau's Montana station with the view of infusing new blood in the brood stock, and the product of an equal number of steelhead eggs shipped from the Birdview (Wash.) station will also be reared with that end in view. The adult brook trout, consisting of 625 2-year-old fish and 35 fish 3 years old and over, yielded 58,000 eggs. These fish were again affected by a gill disease just prior to the spawning season and suffered a heavy mortality. Brook-trout eggs to the number of 550,000 were obtained from commercial dealers in Massachusetts and incubated with satisfactory results. The cold weather of the late spring reduced the output of largemouth black bass to 2,500 fingerlings, but better success attended the culture of the rock bass, the distribution of that species amounting to 53,910 No. 1½ fingerlings.

NEOSHO (MO.) STATION.

[FRED J. FOSTER, Superintendent.]

There was a very satisfactory increase in the output of rainbow trout from this station for the fiscal year 1921. The records indicate that the egg shipments were increased over those of the preceding year by 48 per cent, while the increase in the number of fingerling fish distributed was as high as 117 per cent. The improvement was not confined solely to the increased number of fish and eggs produced but has been extended to the quality of the product and a betterment of the condition of the brood stock.

For a number of years the station has been supplied with water from two sources—the Hearrell Spring and the McMahon Reservoir. Observations made by the superintendent led to the belief that the eggs of fish held in ponds supplied from the spring were not equal, either in numbers or quality, to those taken from fish in ponds supplied from the reservoir. For the purpose of testing the soundness of this theory the following experiment was conducted: A number of 3-year-old rainbow trout from the same hatch, which up to the time of the experiment had been held in the same pond, were divided into two equal lots. One lot was placed in pond No. 18, supplied entirely with water from the McMahon Reservoir, and the other was placed in Pond F, supplied largely from Hearrell Spring. The eggs obtained from fish held in the McMahon water proved 82 per cent

fertile, while the rate of fertility of the other lot was only 67. This and further experiments along the same lines gave these results:

Pond.	McMahon water.	Hearell water.	Fertile eggs.	Pond.	McMahon water.	Hearell water.	Fertile eggs.
	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
No. 18.....	100	0	82	No. 5.....	50	50	77
No. 15.....	70	30	80	No. F.....	30	70	67

It is unfortunate that more complete data on these experiments are not available, and perhaps the data at hand can not be accepted as conclusive. Nevertheless, the evidence seemed sufficiently strong to warrant the construction of two new ponds supplied entirely with the McMahon water and the alteration of present lines to admit of a further elimination of the Hearell water from the stock ponds. During the coming year the brood stock of rainbow trout will be held exclusively in ponds supplied with the McMahon water. The nature of the apparent ill effects of the water from Hearell Spring on the adult fish has never been ascertained, but an ovarian affection appears to prevail among the fish that have been retained in that water for any considerable period.

Another item of possible interest in trout culture at the Neosho station was the occurrence of a disease among the fingerling trout, both at the main station and at the Roaring River substation, resulting in some loss. The trouble first appeared as a discoloration of the gills from cream to brown in color, sometimes one and sometimes both gills being affected. This was followed by an apparent disintegration of the tissues and finally by a peculiar sloughing off of the gill. The trouble manifested itself only in the newly constructed ponds or in ponds supplied with water from recently constructed reservoirs. On being removed to surroundings entirely remote from new concrete work the fish recovered rapidly, even in advanced cases where the gill seemed to have been destroyed. After being treated with a 1 to 1,000 solution of copper sulphate these affected ponds were allowed to remain idle for several months, and no trouble in connection with their use has since developed.

The output of pond fishes also shows an improvement over the recent past, the aggregate having been exceeded only in two previous seasons. Further improvement in this line of effort involves some interesting problems. The ovarian trouble of the rainbow trout may be present among the pond fishes held in water from Hearell Spring, and investigations looking toward the solution of this phase of the subject are already under way. The station ponds devoted to the production of the warm-water species are well supplied with natural food for their young, and were fingerling fish produced to the extent of the natural food available the station's output would be materially increased. The warm-water species propagated are largemouth and smallmouth black basses, rock bass, sunfish, crappie, and yellow perch. Artificial nests were tried in connection with the spawning of the largemouth black bass, with results that led the superintendent to recommend their general use. The output of the station by species is indicated in the tabular statement showing the production of fish by stations on page 12.

WHITE SULPHUR SPRINGS (W. VA.) STATION.

[DELL BROWN, Superintendent.]

Work at this station during the year was conducted along the usual lines. The results from trout propagation, both the brook and the rainbow, were of a satisfactory nature, but, on the other hand, the spawning of the two species of the pond fishes turned out to be an almost total failure.

The brood stock of approximately 2,700 female rainbow trout 2 years old and older produced 1,058,900 eggs, or more than a half million in excess of the previous season's collection. Only 68 per cent of them hatched, however, and the cause of this heavy mortality can not be explained. On reaching the eyed stage 447,000 were supplied to applicants and transferred to other stations of the bureau. The remainder were incubated at the station, together with a consignment of 100,000 received from the Wytheville (Va.) hatchery. The brood stock of brook trout, consisting of about 150 3-year-old fish and 350 2-year-old fish, yielded 80,000 eggs, which number was supplemented by the purchase of a million eggs from commercial dealers in New England. The so-called "white-spot" disease caused some mortality among the fry of this species just prior to the feeding stage, and a gill affection was prevalent later among the fingerlings. Eggs to the number of 22,000 were taken from 150 3-year-old albino brook trout. The males of this lot appeared to be lacking in virility, and some difficulty was experienced in obtaining the necessary fertilizing medium. Nine thousand fingerlings resulted from these albino eggs, 1,000 of which were furnished to applicants, leaving 8,000 on hand at the close of the year.

A consignment of adult smallmouth black bass obtained from Lake Erie waters for a brood stock survived the winter without undue loss, numbering 115 at spawning time. During the spring 46 nests of this species were noted in the ponds, and the output of fry amounted to 100,500. The 23 largemouth black bass on hand produced 25,800 fry and 600 fingerling fish. The results from the rock bass and sunfish were negligible. This condition was attributed in part to lack of proper nourishment, it having never been the custom to feed the brood-pond fishes at this station. Steps have now been taken to feed them on beef heart, and the results will be carefully noted.

WYTHEVILLE (VA.) STATION.

[GEORGE A. SEAGLE, Superintendent.]

During the spawning season of the rainbow trout the 2,960 adult females on hand yielded 870,352 eggs, of which shipments totaling 480,000 were transferred in the eyed state to applicants and to other hatcheries of the bureau. The spawning season was unusually protracted, extending from October 10, 1920, to March 15, 1921, the wild fish recently introduced into the brood stock probably being the later spawners.

At the beginning of the spawning season 695 2-year-old fish were turned over to a representative of the scientific division for experiment. From these fish 30,500 eyed eggs and 19,000 fry were returned to the hatchery stock at the end of the season's investigations, and

they are included in the station's output. The experimental work connected with the spawning of the rainbow trout will be continued over a series of years, the operations next year to be conducted at Erwin, Tenn. With this end in view 416 of the adult fish involved in last season's work have been transferred to Erwin.

The output of brook trout from the station was reduced to negligible proportions by an apparently infectious disease which attacked the fry shortly after incubation was completed. Eggs from commercial hatcheries to the number of 274,000 were received, but because of this trouble only 30,900 fry were available for distribution. The output of this species also included 1,900 No. 4 fingerlings carried over from last year's hatch.

The largemouth black bass, usually prolific at this station, produced very few young. The brood stock consisted of 194 fish, and during April 60 nests were counted in one pond. A sudden drop in temperature had the effect of destroying all the eggs deposited, and the few fry produced were the result of a later spawning. The distribution of rock bass consisted of 14,060 fingerling fish Nos. 2 and 3 produced from 230 brood fish, while 10,325 sunfish comprised the output from a stock of 200 breeders of that species. Adult crappie to the number of 47 were carried through the year, but so far as could be ascertained the fish did not spawn, nor have they been known to take food. Of the 20 catfish transferred from the Cold Springs (Ga.) station last year only 5 remained at the end of June, 1921. Because of the rather dense growth of vegetation in the pond in which they were carried nothing could be learned as to any possible spawning activities. A consignment of 500,000 pike-perch eggs received from the Swanton (Vt.) hatchery was successfully incubated, and the resulting fry were planted in New River, Va.

With the view of increasing the efficiency of the work at the Wytheville station, particularly in connection with trout propagation, further repairs and improvements were made in addition to the new water-supply system installed last year. The more important features of this improvement were the demolition of the old wooden building used as a nursery and the construction of a new two-story building 56 by 36 feet. The building is of concrete to the window sills of the second story and of frame construction above that. It will contain 60 standard troughs—20 on the first floor supplied with brook water and 40 on the second level—which may use either brook or spring water, or a mixture of both as may be desirable. An enlarged settling tank and filter are also in process of construction for the correction of the turbid condition to which the spring water is subject for long intervals after heavy rains.

WORK OF POND FISH-CULTURAL STATIONS.

Climatic conditions play an important part in all branches of fish culture, but the success or failure of a season's work at a pond-cultural station is peculiarly susceptible to temperature changes in the spring. If the weather in the early spring is warm, the spawning activities of the fish, particularly the basses, are hastened. Should this condition be followed by a period of falling temperatures, it inevitably results in the desertion of the nests by the adult fish and the loss of practically all the eggs produced.

Future work looking to an increase in the output of the pond fishes must lie along the line of more intensive cultural methods. The proper steps to be taken in this direction are as yet more or less of an unsolved problem, but such studies as have been made would indicate that the problems are subject to satisfactory and practical solution. To the practical fish-culturist the deductions formed by observation of the results obtained from a certain pond giving most excellent results are sometimes seemingly contradicted by the results from another pond where conditions, from the generally accepted theories, are more favorable. Further investigations and studies of these interesting and important problems are urged as being absolutely essential.

Another point in connection with the operation of the pond stations is to determine the most suitable and effective way to distribute the output. The very young fry can not be successfully handled. Even the transfer of such fry to rearing ponds usually meets with a very heavy mortality. On the other hand, if they are retained in the spawning ponds with the adults the first fry appearing are sure to prey to a large extent on the progeny of the later spawners and will themselves fall a prey to the adults. The loss of young fish from cannibalism is large in an artificial pond under the best of conditions. Perhaps the most suitable time to effect the transfer to rearing ponds or to distribute the fish in them is in the advanced fry or No. 1 fingerling stage. At this time they are hardy enough to withstand careful handling, and, being still under the guardianship of the male parent, may easily be taken in a net as they school along the shores of the pond.

SUMMARY OF OUTPUT.

The output of the stations devoted to the culture of the so-called warm-water or pond fishes during the fiscal year 1921 aggregated 2,473,711, as opposed to a production of 1,837,598 the preceding year. The seven stations included in the pond fish-cultural group are given in the table below, with the figures of the aggregate output of each for the fiscal years 1920 and 1921. The Edenton (N. C.) station, though listed with the pond fish-cultural stations, also does important work with the shad and glut herring, mention of which is made on pages 42 and 44 in this report.

OUTPUT OF POND FISH-CULTURAL STATIONS, FISCAL YEARS 1920 AND 1921.

Station.	Output.		Station.	Output.	
	1920	1921		1920	1921
Cold Springs, Ga.....	226,833	279,675	San Marcos, Tex.....	376,500	408,811
Edenton, N. C.....	42,560	32,990	Tupelo, Miss.....	472,420	479,875
Louisville, Ky.....	404,475	1,020,450			
Mammoth Spring, Ark....	39,895	32,325	Total.....	1,837,598	2,473,711
Orangeburg, S. C.....	274,915	219,675			

COLD SPRINGS (GA.) STATION.

[CHARLES W. BULLOCK, Superintendent.]

Five spawning and two rearing ponds were completed during the year at this station, and it was hoped the additional facilities provided would permit of a material increase in output. As at other points in the Southern States, the weather during the bass spawning season was not propitious. There was a heavy spawning during an unusually warm period in March, permitting of the shipment of more than 100,000 advanced fry in April, whereas the distribution does not usually begin before May 1. A sudden cold spell in April caused a drop of 20 degrees in the water temperature. This resulted in destroying what had appeared to be bright prospects for a remarkably successful season. During the cold weather many of the schools disappeared, and the fish hatched later were small and their rate of growth slow. The few stragglers surviving from the schools destroyed preyed freely on the weaker fish. Perhaps not of the least importance in contributing to the disappointing results was the almost total disappearance from the ponds of the cladocerans, copepods, and chironomids that had been observed in abundance during the early spring. While the numbers of bass produced for distribution represent a very fair average for the station, in view of the promising outlook in the early spring the results are disappointing.

At the Harris Ponds substation catfish and bluegills are reared in the same ponds. In certain respects the bluegills can be more satisfactorily handled than the bass, as they take readily to artificial feeding. It is never possible to anticipate results in the propagation of catfish. In certain seasons the output will be ample for all needs, while the next season, under apparently identical conditions, only small numbers of young are produced. During the past season only 5,000 fingerlings were obtained from 60 adults. In the course of the spring one of the ponds were stocked with 50 adult catfish in addition to the bluegills. Later in the season a heavy mortality occurred as a result of a parasitic affection.

Attempts to propagate crappie at this station have not been particularly successful. Two ponds devoted to the species produced 1,750 fingerlings. Two hundred of these were reserved for brood fish, but as they are very shy and nervous, refusing to take artificial food, it is doubted if they will be of much value in that connection.

The station water supply is lacking in lime or other mineral substance, excepting for a trace of silica. The presence of lime in solution has always been considered desirable in pond fish culture. By way of experiment the water supply to one of the ponds was arranged to pass over a cask of lime, and the results are being noted.

The output of the station for the fiscal year consisted of 212,555 largemouth black bass, 4,120 catfish, 1,550 crappie, 61,350 sunfish, and 100 warmouth bass. Approximately 145,000 of the bass were fry, while the others were all of the fingerling size.

EDENTON (N. C.) STATION.

[EDW. M. HAYNES, Superintendent.]

Five ponds at this station are devoted to the production of the pond fishes, and their output for the year consisted of 23,085 large-

mouth black bass and 9,904 sunfish, all of the fingerling $2\frac{1}{2}$ size. Thirty adult crappie, obtained during the season for use as brood fish, failed to reproduce, the fluctuating air and water temperatures during the spawning season having a decidedly unfavorable influence on these fish, as it also did on the bass. No recent changes have occurred in the method of conducting the work at this point.

LOUISVILLE (KY.) STATION.

[CHARLES W. BURNHAM, Superintendent.]

The fiscal year 1921 marks the most successful season in the history of the station in the production of fish. The output aggregated 1,020,450 fry and fingerlings, divided, by species, as follows: Largemouth black bass, 33,100; rock bass, 4,500; smallmouth black bass, 156,700; sunfish, 76,150; and yellow perch, 750,000. These fish were distributed to applicants in Kentucky, Indiana, and Ohio, and liberal plants of sunfish were made in local waters.

The brood stock of smallmouth black bass was increased during the year by the purchase of 277 adults from Lake Erie fishermen. Of this number 52 died shortly after being received. The remainder were placed in a spawning pond, but failed entirely to spawn. It is difficult to assign a reason for this, as the fish appeared to be in a healthy condition throughout. A number of those that died from the effects of transportation were examined and found to be carrying eggs, and the 125 older fish at the station produced very excellent results under similar conditions.

It is perhaps worthy of mention here that of the 200 adult smallmouth black bass sent to the Mammoth Spring (Ark.) station from Lake Erie none survived the winter. In connection with the propagation of the basses, it is interesting to note that the young smallmouth black bass grow much more rapidly than the young of the largemouth black species.

Yellow-perch propagation at Louisville was successful this season, the 750,000 fry distributed being the progeny of 300 brood fish. It may be possible to considerably extend this branch of the work by increasing the number of breeders carried in the ponds.

MAMMOTH SPRING (ARK.) STATION.

[WILLIAM S. VINCENT, Superintendent.]

A considerable amount of work looking to the improvement of the pond system was accomplished at this station during the year. Such work in the main has consisted in the installation of concrete "kettles" and outlets in many of the ponds, comprising what is believed to be an innovation in pond construction. (See Fig. 3, opp. p. 68.) Improvements were also made in the drainage system. Four small rearing ponds were converted into one large one, and work was done for the improvement and increased fertility of the bottoms of the ponds.

In an effort to build up the brood stock a number of adult fish of the various species propagated were obtained from local waters during the late summer and early fall. In October 200 adult smallmouth black bass were transferred from Lake Erie. Most of these were unable to survive the winter, and all had perished prior to the

spawning season. Hence, the total number of brood fish of this species on hand at that period did not exceed 200. The smallmouth black bass were first observed to be spawning on March 28, when 12 nests were noted, and 38 nests had been occupied by April 8. By the end of the third day fungus had entirely destroyed the eggs on the first 12 nests, and only a negligible number of fry was produced from the remainder of the first spawning. Spawning was resumed on May 6 and 7, when 12 more nests were occupied. From this spawning the total output of smallmouth black bass, amounting to 26,500 fry and fingerling fish, was obtained. No satisfactory explanation for the failure of the early spawning is at hand. The long interval between the spawning periods observed this season is unusual. In previous years it has rarely exceeded one week. In addition to the smallmouth black bass, smaller numbers of the largemouth black bass and rock bass were distributed.

ORANGEBURG (S. C.) STATION.

[GEORGE W. N. BROWN, Superintendent.]

At this station a new pond, approximately 1 acre in area and supplied with water from springs at the head of the small cove in which it is built, was completed and stocked with bass. The output consisted of 204,675 largemouth black bass, 300 crappie, 500 rock bass, and 14,200 sunfish (bluegills), all of fingerling size. A small number of sunfish carried over from the previous year were distributed in connection with the current season's hatch. The station has also a small stock of the spotted catfish (*Ictalurus punctatus*), and it was estimated that approximately 1,000 young of the species were on hand at the close of the year.

SAN MARCOS (TEX.) STATION.

[MARK RILEY, Superintendent.]

The distributions from this station for the year 1921 included the following species: Largemouth black bass, 257,715; catfish, 70,000; crappie, 5,904; rock bass, 320; sunfish, 74,872. The San Marcos station has for a number of years been successful in producing goodly numbers of fish for distribution at a cost that compares favorably with that at any other station. Local conditions seem particularly suited to the purpose, and, unlike the conditions at all other stations, it is not necessary to supply artificial food for either the young or the adult fish. The output for the year 1921 was curtailed by fluctuating water temperatures during the spring and, further, by the ponds overflowing on two occasions, an occurrence that is caused by the unsatisfactory method of street drainage. To augment the production of fish beyond the capacity of the station ponds it has been customary to stock privately owned ponds or "tanks" with fish, with the understanding that the bureau shall have the privilege of taking a reasonable number of the progeny for distribution. Very satisfactory results have been obtained by this method, particularly with the crappie.

TUPELO (MISS.) STATION.

[DAVID DAVIES, Superintendent.]

The output of this station for the year consisted of 405,500 largemouth black bass, 73,005 sunfish, and 1,280 crappie, and the distribution was extended to approximately 310 applicants, located in Mississippi, Alabama, Tennessee, Arkansas, Louisiana, and Kentucky. The station output was also supplemented by a carload shipment of miscellaneous fishes from the rescue field on the upper Mississippi River, consisting of crappie, catfish, rock bass, buffalofish, carp, and yellow perch, all of which entered into the general distributions.

Of possible interest in connection with pond fish culture was the unusually late spawning of the largemouth black bass this year. On August 19, 1921, a lot of 3,000 advanced largemouth black-bass fry were taken from one of the station ponds, and again, on September 28, another lot of the same species and size was obtained.

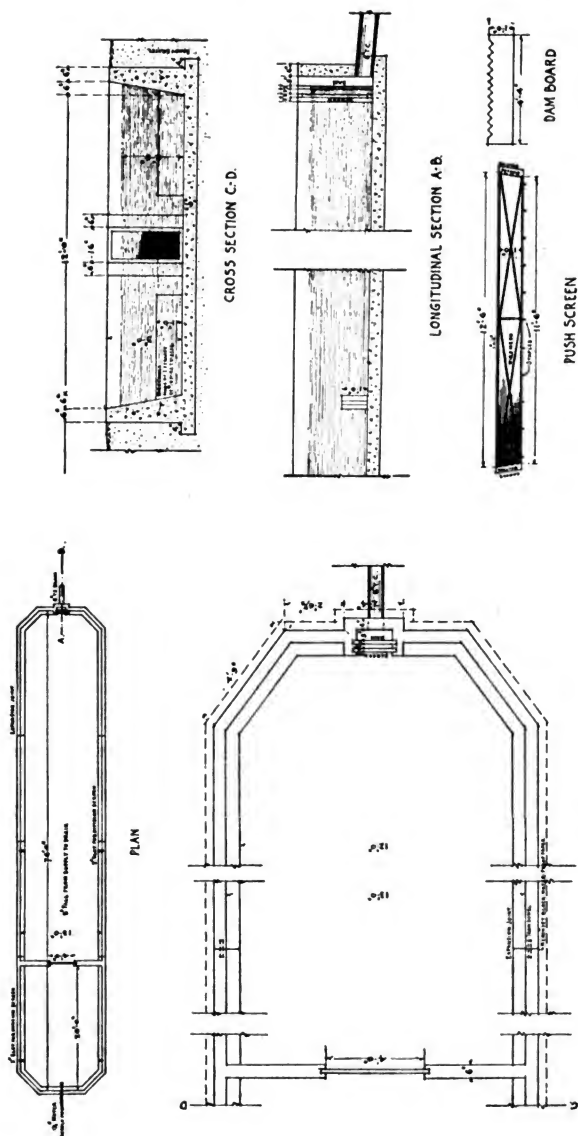
PRACTICAL DEVICES FOR USE IN POND FISH CULTURE.

A PRACTICAL SYSTEM OF CLEANING FISHPONDS.

The necessity for the frequent cleaning of ponds in which fish are retained under artificial conditions is well known. If the ponds are of cement or lumber construction, the usual method of cleaning is to lower the water level and scrub the sides and bottom of the pond with a suitable brush. During the cleaning process the water in the pond becomes turbid and polluted from stirring up the accumulated sediment and filth from the bottom of the pond. The fish are forced to endure this unnatural condition until the pond is scrubbed, the accumulation of sediment flushed out through the outlet, and the pond again filled with clear water. In addition to this unfavorable condition to which the fish are exposed they are subject to further possible injury by bruises from contact with the brushes used in the scrubbing process. These conditions are entirely unavoidable under the system of cleaning in general use.

At the Manchester (Iowa) station a system of cleaning ponds that successfully overcomes both these difficulties has been adopted. (See Fig. 2.) At this station there are eight stock ponds of cement construction. They are approximately 80 by 13 feet and are 3 feet deep at the outlet, the bottom sloping upward toward the inlet, where the depth is 2½ feet.

For the proper cleaning of the ponds a cement wall or dam, extending into the pond 4½ feet from each side, is installed, leaving a 4-foot opening in the middle. This dam is placed 20 feet from the inlet end of the pond and is 1 foot high. The open ends are grooved to accommodate a dam board 2 inches in thickness. In cleaning the pond the water level is lowered until that portion of the pond bottom between the inlet and the division wall is just covered. The pond being deeper at the outlet end, there is still sufficient water to hold the fish safely while the other section of the pond is being cleaned and flushed. After cleaning the first section the water is permitted to rise until the division wall is about submerged. The fish are then driven through the 4-foot opening in the wall into the clean section of the pond by the use of a "push screen." A board



DETAIL PLAN

Fig. 2.—Plan of dam and "push screen" for convenient cleaning of stock fishponds. (Designed by F. E. Hare.)

2 inches thick, 1 foot wide, and 4 feet long is inserted in the grooves in the ends of the division wall to retain the fish, while the remaining portion of the pond is being cleaned. The dam board has a saw tooth edge permitting the overflow water to pass but preventing the escape of the fish.

The "push screen" consists of a frame made of 1 by 4 inch lumber, to which is attached poultry netting of 1-inch mesh or smaller if the size of the fish requires. The smaller dimension of the lumber forms the face of the screen, to offer but slight resistance when being pushed through the water. Its shape conforms to the shape of the ponds. At Manchester the sides flare outward. In size it is somewhat shorter than the width of the pond for convenient handling, and to prevent the escape of fish around the ends strips of heavy duck or canvas belting are attached to each end of the screen. Iron staples driven into the bottom board at suitable intervals and slightly protruding will serve to keep the board from dragging on the bottom of the pond and facilitate the easy movement of the screen through the pond.

POND OUTLET AND "KETTLE."

As being of possible interest and value to persons interested in the subject a drawing of the pond outlet and "kettle" previously mentioned (p. 64), with descriptive text and specifications for construction, are given (Fig. 3).

In referring to the cut of the pond outlet and "kettle" it will be noted that it contains features not embodied in other constructions of a similar character. The drain box is made in about the same manner as those now in use at many stations, but in place of the wooden dam boards it has a cement dam *B*, the height of which is determined by the water level when the pond is filled. If it is desired to raise the water level of the pond, the wooden dam boards can be dropped in the slot *C*. The screen *D* is the same as those now in use. To draw down the water in the pond, a gate valve *A* is so placed at the bottom that all of it can be drawn through the kettle. To make this removable, a flanged valve of the standard low-pressure type is used. A short nipple with a flange on one end is placed in the forms when making the drain box. Later a rubber gasket is cut to size and the gate valve is bolted into place. It is not necessary to bolt the valve around the bottom, since it may be desirable at some time to remove it, and it would be a difficult matter to get at bolts so located. A 6-inch gate valve as described above measures approximately $10\frac{1}{2}$ inches from face to face of flanges. Therefore, a standard valve should be used in place of the medium or heavy service valves. It will be necessary to place the flange of the nipple as close to the cement dam *B* as possible. Therefore, the bolts should be put in place before cementing.

Another feature of the plan is the construction of a cement "kettle" in front of the drain box. It will be noted that the side walls of this kettle extend approximately 12 inches above the earth floor of the pond, so that in drawing down the water in the pond when it drops below this point it must then enter at the sluice gates *I*. The small fish will be drawn down through these gates and will immediately seek the more quiet water at the upper end of the kettle.

The water in this portion of the kettle is more or less clear. If only a few fish are desired, they can sometimes be dipped out with the ordinary hand dip net. In some instances it has been found advisable to put a cement walk around the outside of the kettle. This enables the fish-culturist to dip the fish out with greater ease and without agitating the mud on the earth bottom of the pond.

When it is desired to draw the water entirely off the pond, it is first lowered to about one-half its depth and the mud on the bottom of the kettle is stirred with a long-handled spade or broom until it is well agitated, when the gate valve *A* is opened wide and it is flushed out. After this the pond may be drawn down slowly and the fish drawn into the kettle. When the earth bottom of the pond is bare, there will be 1 foot of water in the kettle.

A 6-inch gate valve is sufficiently large for a pond one-half acre or less in area, an 8-inch valve for a three-fourths acre pond, and a 10-inch valve for a 1-acre pond.



SPECIFICATIONS.

Gate valve *A* is flanged and bolted to companion flanges *F* on nipple *E*, which passes through the center of cement dam *B*. The height of dam *B* is to correspond with the desired water level in the pond. Should it be necessary to raise the water level, wooden dam boards may be dropped in the slot *C*. *D* is the screen made in one or two sections, with a mesh in accordance with the size of fish to be carried. The gate valve should be set low enough for the water to drain out of the kettle *H*. Kettle *H* is constructed with end and side walls 12 inches higher than the earth bottom of the pond.

Preparatory to drawing down the pond for the removal of the fish the water is lowered by opening the gate valve with extension rod *J* to a point where it is possible to clean the bottom of the kettle with a long-handled brush. The mud and roily water is flushed out by opening the gate valve wide.

In drawing down the pond after the water level drops below the top wall of the kettle all water from the pond must enter at the side sluices *I*. This leaves the water comparatively quiet in the upper end of the kettle. The small fish seek that portion of the kettle and may easily be removed with a hand dip net.

Material in drain box.

Sides 8 inches, bottom 6 inches; total amount concrete, 50 cubic feet.

Cement.....bags--	12	1-2-4 mixture. Sand and broken stone or screened gravel.
Sand.....cubic feet--	22.5	
Stone and gravel.....do-----	45	

Sides 6 inches, bottom 6 inches; total amount concrete, 38 cubic feet.

Cement.....bags--	9	1-2-4 mixture.
Sand.....cubic feet--	17	
Stone or gravel.....do-----	34	

Fittings for drain box.

6-inch standard flanged gate valve.
6-inch companion flange.
6-inch nipple 6 inches long,

Reinforcement for dam.

Galvanized stock fence wire, 24-inch width preferred.

Material for kettle.

Walls 6 inches, bottom 6 inches; total amount concrete, 80 cubic feet.

Cement-----bags--	20	1-2-4 mixture.
Sand-----cubic feet--	38	
Stone or gravel-----do----	75	

MODIFIED FORM OF POND OUTLET.

Figure 4 on page 71 shows a modified form of the outlet just described, Figure 3.

In this outlet terra-cotta pipe has been substituted for iron, and the bell end of the terra-cotta ell, closed by the wooden disk, replaces the gate valve, while the cement dam, screen, removable wooden dam boards, and other features remain the same. When the pond is full, the ell opening is closed by the wooden disk, made tight by the use of clay. The wooden dam boards need not be used unless it is desired to raise the water level above the height of the permanent cement dam. To drain the pond, the wooden dam boards are fitted into their proper place and the wooden disk closing the ell opening in the terra-cotta dam pipe is removed by means of the iron rod to which it is attached. The depth of water at any stage of the operation may be controlled by proper manipulation of the wooden dam boards.

Each of the outlets described here, as well as the one described in a previous publication of the bureau,² has distinctive points of advantage and have been developed in meeting the varied conditions encountered in fishpond construction. It remains for the prospective pond builder to select the type best suited to his needs. The types described here are considered particularly desirable in ponds of comparatively large area or where the amount of water to be carried requires the use of correspondingly large pipe. The convenience of the valve in controlling the flow of water in drawing the pond, Figure 3, is easily recognized, but practically the same results are obtainable with the simpler installation shown in Figure 4, and the cost of fittings for this type will be somewhat less.

Work of Central Station, Washington, D. C.

[L. G. HARRON, Superintendent.]

Beginning with rainbow-trout eggs in December, 1920, and closing with pike-perch eggs in May, 1921, there were incubated in the hatchery apparatus maintained in the fisheries building at Washington for public display 7,717,000 fish eggs, representing eight species of fish—chinook salmon, rainbow and brook trouts, whitefish, cisco yellow perch, pike perch, and shad—from which 6,400,327 fry and fingerlings were distributed to applicants in Maryland, Virginia, West Virginia, Delaware, Pennsylvania, and New York.

² Coker, R. E.: Progress in Biological Inquiries, 1921. Report of the Division of Scientific Inquiry for the Fiscal Year 1921. Appendix VIII, Report, U. S. Commissioner of Fisheries for 1921, 38 pp., 2 figs. (A new Form of Pond Outlet, pp. 21-24, Figs. 1 and 2.) Washington, 1922.

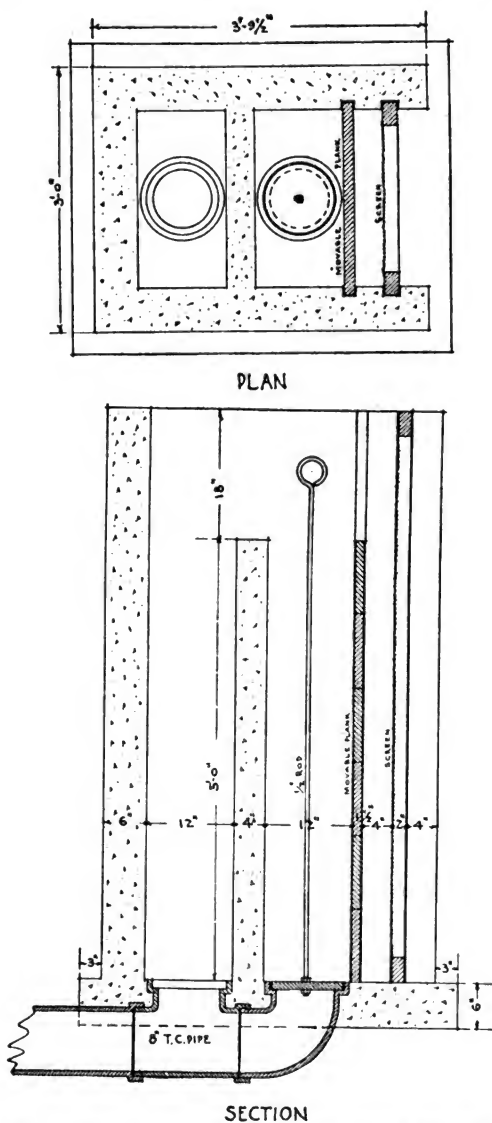


FIG. 4.—Plan of a simple and inexpensive outlet for fishponds.
(Designed by G. C. Leach.)

In addition to the hatchery exhibit a display of adult fresh-water fishes was maintained in the aquaria throughout the year. The total number of fish exhibited was 2,614, representing 45 species. Collections for restocking were made from time to time from the Potomac River at Bryans Point, Md. Other sources of supply were the bureau's stations at White Sulphur Springs, W. Va.; Bellevue, Iowa; Bozeman, Mont.; the New York Aquarium, and the New York Conservation Commission hatchery at Caledonia, N. Y.

The health of the aquaria fishes throughout the year was generally good, with the exception of a short period during May and June, when a number of the fish were attacked by the parasite *Ichthyophthirius*, causing a considerable loss, particularly among the warm-water fishes. It has recently been found that this parasite may be destroyed by treating the fishes infected with a saturated solution of bicarbonate of soda. The solution is conveniently applied directly to the fish when held in shallow water with a small paintbrush. The treatment removes the mucous coating from the fish and destroys the parasite with no injury to the fish.

Spawning Seasons of Fishes Handled at Stations.

Records of the spawning seasons of the various species of fishes handled at the bureau's stations during the fiscal year 1921, together with the water temperatures at the beginning and end of such periods, are given in the following table, in which the stations are grouped and arranged as in the preceding discussion of the propagations of the commercial species and the species for stocking the interior waters; that is, Pacific salmon, Great Lakes, Marine, New England salmon and trout, Rocky Mountain trout, combination trout and pond fish-cultural, and pond fish-cultural stations.

SPAWNING SEASONS OF FISHES HANDLED AT STATIONS, WITH WATER TEMPERATURES AT BEGINNING AND END OF PERIODS, FISCAL YEAR 1921.

PACIFIC SALMON STATIONS.

Station.	Species.	Spawning season.	Water temperatures, °F.	
			Beginning of season.	End of season.
Afognak, Alaska.	Sockeye salmon	July 31 to Sept. 24.	52	40
Baker Lake, Wash.	Silver salmon	Nov. 17 to Dec. 15.	40.5	35.5
	Sockeye salmon	Oct. 10 to Nov. 30.	46	39
Birdsview.	Chinook salmon	Sept. 20 to Oct. 25.	43	41
	Silver salmon	Nov. 20 to Feb. 11.	43	41
	Steelhead salmon.	Mar. 26 to May 21.	44	47
Brinnon.	Chum salmon	Nov. 15 to Jan. 6.	50	48
	Steelhead salmon	Apr. 15 to May 11.	42	52
Duckabush.	Chum salmon	Aug. 28 to Sept. 12.	49	49
	Silver salmon	Nov. 27 to Mar. 1.	46	44
	Steelhead salmon.	Apr. 11 to May 27.	46	45
Quilcene.	Chum salmon, early	Aug. 23 to Oct. 6.	51	50
	Chum salmon, late.	Nov. 4 to Jan. 3.	45	45
	Silver salmon	Oct. 20 to Jan. 20.	47	43
	Steelhead salmon.	Mar. 22 to June 1.	45	49
Quinalt.	Chinook salmon	Oct. 1 to Nov. 15.	47	40
	Silver salmon	Nov. 3 to Dec. 15.	42	40
	Sockeye salmon	do.	42	40
Sultan.	Chinook salmon	Sept. 13 to Oct. 15.	51	47
	Silver salmon	Oct. 8 to Feb. 2.	49	42
	Steelhead salmon.	Mar. 10 to May 28.	42	45

SPAWNING SEASONS OF FISHES HANDLED AT STATIONS, ETC.—Continued.
 PACIFIC SALMON STATIONS—Continued.

Station.	Species.	Spawning season.	Water temperatures, °F.	
			Begin- ning of season.	End of season.
Clackamas, Oreg.....	Chinook salmon.....	Sept. 19 to Nov. 15.....	56	48
Upper Clackamas.....	Chinook salmon, spring run.....	Aug. 25 to Sept. 24.....	59	60
Little White Salmon...	Chinook salmon.....	Sept. 19 to Oct. 14.....	47	46
	Chum salmon.....	Oct. 28 to Dec. 2.....	32	39
	Silver salmon.....	Nov. 26 to Dec. 2.....	41	39
Big White Salmon.....	Chinook salmon.....	Sept. 19 to Oct. 15.....	42	47
Rogue River.....	Blackspotted trout.....	Mar. 20 to May 12.....	40	46
	Chinook salmon, spring run.....	Aug. 11 to Oct. 15.....	56	40
	Silver salmon.....	Oct. 10 to Nov. 25.....	45	40
Applegate Creek.....	Steelhead salmon.....	Feb. 26 to May 10.....	40	46
	Chinook salmon.....	Nov. 1 to Dec. 1.....	42	40
	Silver salmon.....	Nov. 18 to Mar. 1.....	40	40
	Steelhead salmon.....	Jan. 5 to May 19.....	37	50
Washougal River.....	do.....	May 10 to June 2.....	48	62
Salmon, Idaho.....	Chinook salmon, spring run.....	Aug. 14 to Sept. 15.....	63	60
Baird, Calif.:				
Battle Creek.....	Chinook salmon.....	Oct. 19 to Nov. 14.....	48	49
Mill Creek.....	do.....	Oct. 26 to Nov. 18.....	54	52

GREAT LAKES STATIONS.

Duluth, Minn: Marquette, Mich.....	Lake trout.....	Oct. 10 to Nov. 10.....		
Northville, Mich: Charle- voix.....	do.....	Nov. 12 to 26.....	48	45
Put in Bay, Ohio:				
Catawba Island.....	Whitefish.....	Nov. 13 to 29.....	40	41
North Bass Island.....	do.....	Nov. 10 to 29.....	42	41
Port Clinton.....	Carp.....	May 2 to June 13.....	68	75
	Pike perch.....	Apr. 5 to 24.....	48	49
	Whitefish.....	Nov. 13 to 29.....	40	41
Toledo.....	Pike perch.....	Apr. 8 to 24.....	48	49
Cape Vincent, N. Y.:				
Bygotts Point.....	Cisco.....	Nov. 22 to Dec. 1.....	35	32
	Whitefish.....	Nov. 10 to 23.....	43	34
Pigeon Island.....	Lake trout.....	Nov. 1 to 15.....	60	48
St. Lawrence River....	Yellow perch.....	May 15 to June 15.....	46	50

BRYANS POINT (MD.) STATION.

Bryans Point, Md.....	Yellow perch.....	Mar. 10 to 23.....	53	57
	Shad.....	Apr. 22 to May 2.....	50.5	57

MARINE STATIONS.

Boothbay Harbor, Me.....	Flatfish.....	Mar. 10 to Apr. 22.....	36	45
Gloucester, Mass.....	Cod.....	Jan. 15 to Apr. 29.....	38	48
	Haddock.....	Jan. 22 to Apr. 25.....	36	46
	Pole flounder.....	May 22 to end of summer, probably.....	56	
	Pollock.....	Nov. 15 to Jan. 21.....	46	36
	Winter flounder.....	Mar. 18 to Apr. 22.....	40	46
Woods Hole, Mass.....	Cod.....	Nov. 26 to Feb. 4.....	45	34
	Winter flounder.....	Jan. 16 to Mar. 30.....	38	43

NEW ENGLAND SALMON AND TROUT STATIONS.

Berkshire, Mass.....	Brook trout.....	Oct. 21 to Nov. 10.....	41	41
	Rainbow trout.....	Dec. 22 to Jan. 20.....	44	40
Craig Brook, Me.....	Atlantic salmon.....	Oct. 20 to Nov. 12.....	35	40
Green Lake, Me.....	Landlocked salmon.....	Nov. 10 to Dec. 1.....	48	37
	Smelt.....	Apr. 20 to 22.....	51	51
Grand Lake Stream.....	Landlocked salmon.....	Oct. 31 to Nov. 28.....	54	26
Nashua, N. H.....	Brook trout.....	Nov. 3 to Dec. 20.....	48	47
	Rainbow trout.....	Nov. 3 to Dec. 23.....	48	46
St. Johnsbury, Vt.....	Brook trout.....	Oct. 15 to Nov. 1.....	54	43
	Lake trout.....	do.....	54	43

SPAWNING SEASONS OF FISHES HANDLED AT STATIONS, ETC.—Continued.

ROCKY MOUNTAIN TROUT STATIONS.

Station.	Species.	Spawning season.	Water temperatures, °F.	
			Begin- ning of season.	End of season.
Bozeman, Mont.:				
Meadow Creek, Mont.	Rainbow trout.....	Apr. 15 to June 10.....	43	54
Yellowstone Park, Wyo.	Blackspotted trout.....	June 13 to July 22.....	40	55
Leadville, Colo.	Brook trout.....	Oct. 10 to Dec. 7.....	40	52
Saratoga, Wyo.	do.....	October and November.....	51	41
	Rainbow trout.....	April and May.....	48	54
	Loch Leven trout.....	October and November.....	51	41
Spearfish, S. Dak.	Brook trout, brood stock..	Oct. 25 to Jan. 14.....	46	44
	Loch Leven trout, wild fish.	Oct. 16 to Dec. 12.....	46	45
	Rainbow trout, brood stock.	Jan. 18 to Mar. 20.....	44	20
Springville, Utah:				
Fish Lake.....	Brook trout.....	Nov. 1 to 14.....	42	42
	Rainbow trout.....	May 1 to June 4.....	42	42

COMBINATION TROUT AND POND FISH-CULTURAL STATIONS.

Erwin, Tenn.	Brook trout.....	Oct. 1 to Jan. 1.....	54	53
	Carp.....	May 1 to July 1.....	54	54
	Catfish.....	June 1 to Oct. 20.....	54	54
	Largemouth black bass....	Apr. 15 to June 1.....	54	54
	Rainbow trout.....	Nov. 1 to Jan. 15.....	53	50
	Rock bass.....	May 1 to Sept. 1.....	54	54
	Smallmouth black bass....	Apr. 15 to June 1.....	54	55
	Sunfish.....	May 1 to Sept. 1.....	54	54
	Yellow perch.....	Mar. 1 to Apr. 30.....	54	54
Manchester, Iowa.	Brook trout.....	Nov. 4 to Dec. 17.....	50	50
	Largemouth black bass....	May 15 to June 1.....	50	50
	Rainbow trout.....	Dec. 22 to Apr. 19.....	50	50
	Rock bass.....	May 15 to June 1.....	50	50
Neosho, Mo.	Crappie.....	April and May.....	57	57
	Largemouth black bass....	Apr. 8 to June 20.....	57	56
	Rainbow trout.....	November to February.....	57	57
	Rock bass.....	Apr. 21 to July 15.....	57	55
	Smallmouth black bass....	Apr. 22 to June 10.....	57	56
	Sunfish.....	May 10 to Sept. 1.....	57	56
	Yellow perch.....	Apr. 8 to 20.....	57	57
White Sulphur Springs, W. Va.	Brook trout.....	Nov. 15 to Dec. 13.....	53	50
	Largemouth black bass....	May 1 to 25.....	64	73
	Rainbow trout.....	Nov. 11 to Jan. 31.....	53	49
	Rock bass.....	May 1 to June 15.....	67	75
	Smallmouth black bass....	May 1 to 25.....	64	71
	Sunfish.....	May 1 to June 15.....	67	75
Wytheville, Va.	Largemouth black bass....	Apr. 15 to June 20.....	60	60
	Rainbow trout.....	Oct. 10 to Mar. 15.....	54	54
	Rock bass.....	May to July.....	60	60
	Smallmouth black bass....	Apr. 15 to June 20.....	60	60
	Sunfish.....	May to July.....	60	60

POND FISH-CULTURAL STATIONS.

Cold Springs, Ga.	Catfish.....	May 1 to June 30.....	64	80
	Crappie.....	Apr. 1 to June 30.....	61	80
	Largemouth black bass....	Mar. 15 to July 15.....	64	72
	Sunfish.....	Apr. 1 to July 31.....	61	72
Edenton, N. C.	Largemouth black bass....	Mar. 20 to June 15.....	64	80
	Sunfish.....	June 1 to July 15.....	74	80
Louisville, Ky.	Largemouth black bass....	Apr. 7 to 24.....	60	64
	Rock bass.....	Apr. 24 to June 15.....	64	76
	Smallmouth black bass....	Apr. 14 to May 2.....	60	61
	Sunfish.....	Apr. 25 to June 30.....	68	85
	Yellow perch.....	Mar. 28 to Apr. 7.....	58	56
Mammoth Spring, Ark.	Rock bass.....	May 1 to June 1.....	50	60
	Smallmouth black bass....	Mar. 28 to May 7.....	67	64

SPAWNING SEASONS OF FISHES HANDLED AT STATIONS, ETC.—Continued.

POND FISH-CULTURAL STATIONS—Continued.

Stations.	Species.	Spawning season.	Water temperatures, °F.	
			Begin- ning of season.	End of season.
Orangeburg, S. C.	Catfish.....	Apr. 25 to June 30.....	74	78
	Crappie.....	Apr. 10 to June 30.....	70	78
	Smallmouth black bass.....	Mar. 15 to June 1.....	63	76
	Sunfish.....	Apr. 5 to June 30.....	68	78
San Marcos, Tex.	Crappie.....	March through June, mainly.....		
	Largemouth black bass.....	Whole year, but mainly March through May.....		
Tupelo, Miss.	Sunfish.....	Whole year.....		
	Crappie.....	Apr. 5 to May 20.....	68	77
	Largemouth black bass.....	Mar. 15 to June 1.....	69	82
	Sunfish.....	Apr. 14 to June 20.....	63	83

Fish Food Used at Fish-Cultural Stations.

AMOUNT AND COST OF FISH FOOD USED.

The ideal condition sought by all fish-culturists is a water area so arranged that a natural food supply is available when needed, but from our present knowledge the ideal is impossible of attainment in most cases and artificial feeding must be resorted to. In the rearing of fish under artificial environment, therefore, the problem of a satisfactory food supply at a reasonably low cost is ever present.

The following table gives for the fiscal year 1921 the number of pounds and the cost per pound of artificial fish food used at the various fish-cultural stations during the fiscal year 1921:

POUNDS AND COST PER POUND OF FISH FOOD USED, FISCAL YEAR 1921.

PACIFIC SALMON STATIONS.

Station.	Salted salmon.		Canned salmon.		Frozen salmon eggs.		Beef liver.	
	Lbs.	Cost.	Lbs.	Cost.	Lbs.	Cost.	Lbs.	Cost.
Atognak, Alaska.....	890	\$0.015						
Yee Bay, Alaska.....	600	.03						
Baker Lake and substations, Wash.....	1,215	.03					114	\$0.15
Quinalt, Wash.....	3,000	.015						
Clackamas, Oreg., and substations.....	43,200	.03	9,000	\$0.001	9,440	\$0.04		
Baird, Calif., and substations.....	8,000	.01					880	.11
Total.....	56,875		9,000		9,440		994	

Station.	Beef spleen.		Pork liver.		Milk.		Wheat mid- dling.	
	Lbs.	Cost.	Lbs.	Cost.	Gals.	Cost.	Lbs.	Cost.
Atognak, Alaska.....								
Yee Bay, Alaska.....								
Baker Lake and substations, Wash.....	2,886	\$0.05			176	\$0.25		
Quinalt, Wash.....			2,230	\$0.07				
Clackamas, Oreg., and substations.....	10,395	.045					760	\$0.03
Baird, Calif., and substations.....								
Total.....	13,281		2,230		176		760	

POUNDS AND COST PER POUND OF FISH FOOD USED, FISCAL YEAR 1921—Continued.
NEW ENGLAND SALMON AND TROUT STATIONS.

Station.	Beef liver.		Beef hearts.		Beef spleen.		Sheep liver.		Pork liver.		Fishotone.	
	Lbs.	Cost.	Lbs.	Cost.	Lbs.	Cost.	Lbs.	Cost.	Lbs.	Cost.	Lbs.	Cost.
Berkshire trout hatchery, Mass.	1,336	\$0.13			4,100	\$0.05	372	\$0.05	347	\$0.07		
Craig Brook, Me.	192	.12										
Green Lake, Me.	352	.10					80	.07	170	.05		
Nashua, N. H.	1,263	.08	215	\$0.05			1,337	.04	512	.06		
St. Johnsbury, Vt.	758	4.08									57	\$0.00
Total.	3,892		215		4,100		1,789		1,029		57	

ROCKY MOUNTAIN TROUT STATIONS.

Station.	Beef liver.		Beef hearts.		Beef spleen.		Sheep liver.		Wheat chop.	
	Lbs.	Cost.	Lbs.	Cost.	Lbs.	Cost.	Lbs.	Cost.	Lbs.	Cost.
Bozeman, Mont.	9,649	\$0.09								
Leadville, Colo.	32	.12	2,711	\$0.08						
Spearfish, S. Dak.	922	.12	1,280	.12			2,680	\$0.07		
Springville, Utah.	4,234	.07	1,018	.07	1,770	\$0.05	8,064	.06	4,000	\$0.03
Saratoga, Wyo.	3,997	1.08					835	.04		
Total.	18,834		5,009		1,770		11,579		4,000	

COMBINED TROUT AND POND FISH-CULTURAL STATIONS.

Station.	Beef liver.		Beef hearts.		Sheep liver.		Sheep hearts.	
	Lbs.	Cost.	Lbs.	Cost.	Lbs.	Cost.	Lbs.	Cost.
Erwin, Tenn.			2,896	\$0.08	6,431	\$0.06		
Manchester, Iowa			2,637	.06	13,097	.03		
Neosho, Mo.			385	.06	10,919	.04		
White Sulphur Springs, W. Va.	74	\$0.09	2,903	.06	21,387	.04	8,275	\$0.04
Wytheville, Va.			2,705	.08	6,882	.06		
Total.	74		11,526		59,316		8,275	

Station.	Canned herring milt.		Meatln.		Azotine.		Shorts.	
	Lbs.	Cost.	Lbs.	Cost.	Lbs.	Cost.	Lbs.	Cost.
Erwin, Tenn.	96	\$0.14	200	\$0.08			5,330	\$0.04
Manchester, Iowa							200	.03
Neosho, Mo.							4,000	.03
White Sulphur Springs, W. Va.	96	.14						
Wytheville, Va.					250	\$0.07	5,825	.04
Total.	192		200		250		15,325	

POND FISH-CULTURAL STATIONS.¹

Station.	Beef liver.		Beef hearts.		Fresh fish.		Fishotone.		Shorts.	
	Lbs.	Cost.	Lbs.	Cost.	Lbs.	Cost.	Lbs.	Cost.	Lbs.	Cost.
Cold Springs, Ga.			285	\$0.08	5,154	\$0.16	400	\$0.09	400	\$0.04
Edenton, N. C.	59	\$0.20			269	.15				
Louisville, Ky.			289	.15						
Mammoth Spring, Ark.			446	.12						
Orangeburg, S. C.			971	.12						
Tupelo, Miss.			1,908	.11						
Total.	59		3,904		5,423		400		400	

¹ Beef liver and hearts combined.² No artificial foods used at the San Marcos (Tex.) station.

FOOD FOR BASS.

One of the principal problems encountered at most of the pond fish-cultural stations pertains to a suitable food supply for both young and adult bass. At the Cold Springs (Ga.) station fresh mullet was for a number of years the staple food for the bass, but this material has not given entire satisfaction, and recently the price has been prohibitive. Beef hearts and groupers have been tried, but the fish show some reluctance in accepting either of these materials. More recently pork hearts have been tried with very satisfactory results.

TESTS WITH HERRING MILT AS FOOD FOR RAINBOW TROUT.

During the past year the bureau has purchased several cases of canned herring milt for the purpose of testing its value as a food for young rainbow trout. It has been tried at several hatcheries, and while the results of the tests made in comparison with other foods in more general use are not necessarily conclusive they seem to indicate that canned herring milt when used alone is not a satisfactory article of diet for young trout, though when used in combination with a meat product it may perhaps be considered a desirable article for the fish-culturists to keep on hand as an emergency food. It has the advantage of being easily prepared, does not "smoke" or discolor the water, and will keep for a long period.

A noticeable feature in connection with this experiment is that for a short period—ranging from 10 to 17 days—the fish receiving herring milt exclusively appeared to thrive equally as well as those receiving a meat diet and the mortality was not greater, but beyond that time the death rate increased so rapidly that in most cases the experiments were discontinued, as it appeared that none of the fish would survive under the treatment. A change to the usual foods appears to have restored normal conditions among the fish.

The tabulated statement of the results of these tests in feeding may be of interest. Rainbow trout were involved exclusively, and in each instance the fish had not previously received artificial food.

RESULTS OF TESTS WITH HERRING MILT AS FOOD FOR RAINBOW TROUT.

ERWIN (TENN.) STATION.

[Test continued for 16 days—2,500 fish per trough.]

Trough number.	Food used.	Weight per 1,000 fish—			Loss per 1,000 fish during test.
		At beginning of test.	At end of test.	Gained during test.	
		Ounces.	Ounces.	Ounces.	Per cent.
1.....	Beef heart.....	6	8	2	7½
2.....	Canned herring milt.....	6	7	1	21½

RESULTS OF TESTS WITH HERRING MILT AS FOOD FOR RAINBOW TROUT—Contd.

NEOSHO (MO.) STATION.

[Test continued for 30 days—2,000 fish per trough.]

Trough number.	Food used.	Weight per 1,000 fish.			Loss per 1,000 fish during test.
		At beginning of test.	At end of test.	Gained during test.	
		Ounces.	Ounces.	Ounces.	Per cent.
1.....	Canned herring milt 3 days, beef hearts 3 days, alternately.....	6	12½	6½	1½
2.....	Canned herring milt 3 days, sheep liver 3 days, alternately.....	6	11½	5½	5½
3.....	Beef heart.....	6	19½	13½	1½
4.....	Sheep liver.....	6	12	6	4½

WHITE SULPHUR SPRINGS (W. VA.) STATION.

[Test continued for 20 days—10,000 fish per trough.]

1.....	Canned herring milt.....	4½	8½	4	12½
2.....	Sheep liver.....	4½	9½	5	1½
3.....	Canned herring milt 10 days, sheep liver 10 days, alternately.....	4½	9	5	1½

WYTHEVILLE (VA.) STATION.

[Test continued for 10 days—13,000 fish per trough.]

1.....	Canned herring milt.....	4½	5	½	7½
2.....	Beef heart.....	4½	6½	1½	3½

Rescue Operations.

[C. F. CULLER, in Charge.]

OUTLINE OF POSSIBLE EXTENSION.

So much has already been said regarding the importance of the rescue operations conducted in the Mississippi Basin, their value, simplicity, practical returns, and comparatively low cost that these phases of the work should be familiar to all interested persons. A brief outline of the possibilities of extending the work, with suggestions as to its requirements, may not be out of place, in view of the bill now pending before Congress to provide funds for enlarging its scope. Almost unlimited possibilities exist for the further extension of the work. In the bureau's greatest effort during the fiscal year 1920, when approximately 160,000,000 of fishes were saved, not more than 40 per cent of the available territory was covered. There are many miles of unbroken stretches of river lowlands where floods annually result in the destruction of millions of fish, while the major tributaries of the Mississippi afford a field of unknown possibilities. For the economical and efficient conduct of the work it would be desirable to establish headquarters near the central point of the more important operations, with a personnel available for its prosecution at all times. Under present arrangements the personnel for the rescue work is drawn from four of the regularly established

fish-cultural stations. This diversion is apt to result in a comparative lack of interest in the work of the home stations, and not infrequently it curtails their operations. Moreover, men drawn from other lines of activities can not be expected to be as familiar or as efficient in the prosecution of the rescue work as will men who can devote all their time to it. The work has grown to such proportions that men drawn from the fish-cultural stations can no longer handle it to the fullest advantage under such conditions.

The rescue field would afford profitable employment for such a force throughout the year, the line of operations to be something as follows: Rescue of fishes along the upper reaches of the river would occupy the attention of the men from July to December, during which time a crew of five men could save from 8,000,000 to 10,000,000 fish, at a total approximate cost of \$2,000. That number of fish purchased from commercial fish-culturists would cost the bureau from \$25,000 to \$30,000 and to citizens of the Mississippi Valley would represent a food value of \$1,000,000 to \$1,500,000 when placed on the market three years after being rescued. These figures are very conservative when compared with the results attained at the bureau's regularly established fish-cultural stations. At the close of the rescue season important work in the salvage of eggs in connection with the commercial fisheries in Louisiana would consume practically all the time of the men from February to April. From Louisiana the crew would work northward to the confluence of the Ohio and the Mississippi Rivers, where important fields are open in the three adjoining States. The Illinois River overflows its dikes during the spring freshets, and in May or early June large pumps are operated to remove the water from the land. Many millions of young fish are thus left in the fields to perish or are passed through the pumps and destroyed. During the comparatively short periods when active rescue work is not under way the time could be profitably employed in repair and maintenance of the equipment used.

In addition to a personnel provided especially for the rescue work there should be two or three additional holding stations, these being essential for the "hardening" of the fish required for distribution. A part of the rescued fish are held in tanks of clear water and "hardened" for several days to enable them to withstand transportation. They are then shipped in the bureau's specially equipped distribution cars and planted in suitable tributary waters. Experience has shown that greater results can be attained in this way than by returning all fish rescued to the main river. The wider distribution also gives to people living in various parts of the Mississippi Valley a better opportunity to obtain fresh fish.

In addition to the requirements outlined above, houseboats with living quarters for a crew of five or six men should be provided. These boats would be placed in certain sections of the river, and when the pools at one point had been cleaned up they would be moved downstream to other fields. Launches will be needed to transport the crews to and from the fields of operation, to carry supplies, and to distribute fish. It has been found more economical to own launches than to rent them. Boats for hire are seldom in good running condition, and much valuable time is lost in repairs before the men can be placed in the field. There will be necessity for a boathouse and

storeroom at a central point for the proper housing of boats and equipment; also for two dwelling houses to serve as quarters for the men in immediate charge of the work.

Since the Mississippi River is largely a boundary water, most of the States regard the rescue operations as a work belonging to the Federal Government rather than to the States. Most of the States have rendered excellent cooperation; but in many cases their appropriations for rescue and fish-cultural work have been more or less sporadic, hence the work could not be well organized nor efficiently handled. Moreover, most of the States have a problem in maintaining the fish in their interior waters.

Citizens throughout the Mississippi Valley have urged the bureau to extend this valuable work, arguing that they are entitled to fresh fish as a food, and that it should not be necessary for them to depend upon the Pacific coast, the Atlantic coast, or the Great Lakes for their supply. They can not understand why an earnest effort should not be made to save the millions of fish that are dying in pools along the river.

METHODS EMPLOYED IN RESCUING FISH.

A rescue crew usually consists of five men and a foreman. A launch is employed in going to and from the field of operations, and the equipment for each field comprises two seines of one-fourth-inch mesh, from 50 to 75 feet long and 5 feet deep; six galvanized-iron tubs of $1\frac{1}{2}$ -bushel capacity; small dip nets; two tin dippers; and a small flat-bottomed boat, the latter being used in ponds too deep for wading.

After making a haul the fish are assorted into tubs by species and size. The number per tub is ascertained by noting the water displacement, one or more rings having been made on the inside of each tub, and the number established by actual count. The count is verified several times during the season, as the fish in some instances are subject to rapid growth.

When first taken from the warm water the fish will not safely stand a long railway journey. Therefore those intended for distribution are taken to the nearest holding station and hardened by being held for several days in cool running water. While the number of fish diverted for supplying applicants at a distance may seem large in the aggregate, it represents less than 1 per cent of the total collections. Such diversions during the fiscal year 1921 amounted to 660,110 fish of miscellaneous species.

REVIEW OF THE WORK.

The aggregate number of fish rescued during the fiscal year 1921 amounted to 120,656,420, a decrease of almost 36,000,000 as compared with the record of the previous year. Two causes contributed to this result. Labor conditions were unsatisfactory, making it difficult to obtain efficient crews at all points at the rate of compensation offered. The river remained at a high stage for a longer period than usual, thus permitting large numbers of fish bred in the overflow waters to return to the river unaided. This appears to have been particularly true with reference to such species as the carp, buffalofish, and catfish.

The work began at Prescott, Wis., on August 12 and was brought to a close at Bellevue, Iowa, on November 10, these dates indicating an unusually short season on account of the natural conditions mentioned. The work was conducted in the following fields:

One crew, with house boat, from Prescott, Wis., to Red Wing, Minn.; thence to Genoa, Wis.

Two crews on house boats from Wabash to Winona, Minn.; thence to Dakota and Dressback, Minn.

Two crews from Homer, Minn.

One crew from La Crosse, Wis.

One crew from Genoa, Wis.

One crew from Ferryville, Wis.

Two crews from Lynxville, Wis.

One crew from Marquette, Iowa.

One crew with house boat from Dubuque to Bellevue, Iowa.

One crew from Bellevue, Iowa.

In addition to the regular rescue work collections of eggs from carp and buffalofish taken by commercial fishermen were made at Bellevue and Lynxville. The eggs were taken, fertilized, and planted on the natural spawning grounds. Such work was done from May 9 to 25 and resulted in the fertilization of 68,287,000 buffalofish and 42,718,000 carp eggs. Had these eggs not been thus handled they would have been sent to the markets in the fish and lost. While the planting of fertilized eggs is not considered as efficient as incubating them in a well-equipped hatchery, it is believed that under certain conditions it is expedient and results in much good if properly done.

In addition to the operations on the upper Mississippi rescue work was conducted from the Fairport (Iowa) biological station; also on the Illinois River at Meredosia and Cairo, Ill., and at San Marcos, Tex. The operations from Fairport and substations were in conjunction with the propagation of the fresh-water mussel, large numbers of the rescued fish being inoculated with the mussel glochidia before being liberated. Owing to unfavorable water stages the active season at Cairo was very short, extending only from October 1 to 19. In this field one seining crew working under the direction of the superintendent of the Louisville (Ky.) station salvaged a total of 1,057,215 fish of miscellaneous species at a total cost of \$582.07, or at the rate of 55 cents per thousand fish handled. In the vicinity of the San Marcos (Tex.) station 202,886 black bass, catfish, and sunfish were removed from the bed of a stream, which almost entirely evaporated during a protracted hot spell, and were deposited in living waters. Reference to the table on page 7 will show the points from which rescue work was prosecuted during the season, the number of fishes salvaged at each and restored to the original waters, and the number delivered to applicants.

Part 2.—DISTRIBUTION OF FISH AND FISH EGGS.

Extent and Character of the Work.

[E. C. FEARNOW, Superintendent of Fish Distribution.]

BRIEF REVIEW OF THE WORK.

The 4,962,489,405 fish and fish eggs (see table, p. 5) representing the net product of the hatcheries and rescue stations of the bureau for

the fiscal year 1921 were widely disseminated, the distribution reaching practically every State in the Union and the Territories of Alaska and Hawaii. Consignments of fish eggs were also shipped to the Governments of Canada, France, and Switzerland, and an allotment of fish was forwarded to an applicant in Mexico.

Fully 93 per cent of the output is represented by important commercial species—the salmons, shad, whitefish, pike perch, yellow perch, lake trout, cod, pollock, haddock, flounder, buffalofish, and carp. All of such fishes are planted on or adjacent to the spawning areas where the eggs originate, or the eggs are consigned to State commissions for incubation and distribution in nonproductive waters where conditions appear to favor the development of new fisheries. (See p. 87.) Included under the head of the commercial fishes are the large numbers of food fish annually salvaged from the overflowed territory along the Mississippi River and at other points (see pp. 7 and 78), a branch of the work that has become one of the most popular, practical, and beneficial of the bureau's activities.

Among the more important species propagated for the stocking of interior waters are the brook, rainbow, and blackspotted trouts, the largemouth and smallmouth black basses, rock bass, sunfish, crappies, and catfish. While the numbers of such fishes are by comparison small, representing only 7 per cent of the aggregate output, the importance of this work is not to be underestimated. It is this branch of its work which brings the bureau in close contact with the general public, as is evidenced by the large number of applications received each year, and the interest thus aroused in the fisheries can not be other than beneficial. The economic value of the work is large. In most instances the reports received from applicants regarding the results obtained from planting fish furnished by the bureau are of a highly satisfactory nature. (See p. 88.)

SUMMARY OF DISTRIBUTION TO ALL APPLICANTS.

The following table shows in summarized form how many and what species of fish and fish eggs out of the net product of the hatcheries and rescue stations for the fiscal year 1921 were delivered to all applicants, both in the United States and Territories and in foreign countries. Only a small percentage of the immense numbers of fish rescued from overflowed lands was delivered to applicants, the great bulk having been returned to the original waters, as is shown in the table on page 7.

SUMMARY, BY SPECIES, OF DISTRIBUTION OF FISH AND EGGS TO ALL APPLICANTS,
FISCAL YEAR 1921.

[Asterisk (*) denotes eggs; dagger (†), fry; all others are fingerlings or yearlings.]

UNITED STATES AND TERRITORIES.

State and species.	Number.	State and species.	Number.
Alabama:		Illinois:	
Carp.....	45	Brook trout.....	500
Catfish.....	2,240	Buffalofish.....	141,653
Crappie.....	1,900	Carp.....	125,211
Largemouth black bass.....	†153,550	Catfish.....	1,546,730
Rock bass.....	46,565	Crappie.....	148,204
Sunfish.....	4,000	Drum.....	175
	45,300	Lake trout.....	*10,000
Alaska: Sockeye salmon.....	*350,000	Largemouth black bass.....	8,741
	†30,761,000	Pike and pickerel.....	410
	26,977,500	Pike perch.....	250
Arizona:		Rainbow trout.....	*1,000
Brook trout.....	73,000	Rock bass.....	900
Catfish.....	1,200	Sunfish.....	208,350
Crappie.....	2,775	White bass.....	2,510
Rainbow trout.....	37,000	Whitefish.....	*2,000,000
Rock bass.....	200	Yellow perch.....	100
Sunfish.....	1,000	Miscellaneous fishes.....	16,390
Yellow perch.....	300	Indiana:	
Arkansas:		Brook trout.....	{ 124,000
Catfish.....	5,620		22,500
Crappie.....	6,520	Carp.....	25
Largemouth black bass.....	{ 139,000	Catfish.....	1,980
	24,461	Crappie.....	1,040
Rainbow trout.....	49,061	Largemouth black bass.....	{ 112,000
Rock bass.....	10,140		8,775
Smallmouth black bass.....	{ 125,500	Rainbow trout.....	18,500
	2,639	Rock bass.....	600
Sunfish.....	20,120	Smallmouth black bass.....	12,900
Yellow perch.....	1,000	Sunfish.....	2,760
California:		Yellow perch.....	2,275
Chinook salmon.....	{ *3,000,000	Iowa:	
	4,563,400	Brook trout.....	11,775
Rainbow trout.....	*25,000	Buffalofish.....	{ †68,267,000
Steelhead salmon.....	*20,000		557,590
Colorado:			142,718,000
Blackspotted trout.....	†868,500	Carp.....	528,902
Brook trout.....	{ 127,000	Catfish.....	3,272,437
	2,004,050	Crappie.....	6,405,468
Lake trout.....	24,000	Drum.....	2,120
Largemouth black bass.....	9,725	Lake trout.....	*50,000
Loch Leven trout.....	34,000	Largemouth black bass.....	44,797
Rainbow trout.....	{ *200,000	Pike perch.....	37,560
	62,500	Rainbow trout.....	{ *64,500
Sunfish.....	600		5,500
Connecticut:		Rock bass.....	47,000
Brook trout.....	135,600	Smallmouth black bass.....	1,500
Catfish.....	2,400	Sunfish.....	5,230,707
Largemouth black bass.....	2,380	White bass.....	9,410
Pike perch.....	†150,000	Yellow perch.....	223,175
Rainbow trout.....	13,000	Miscellaneous fishes.....	3,487,105
Delaware: Pike perch.....	†500,000	Kansas:	
District of Columbia:		Catfish.....	250
Rainbow trout.....	13,500	Largemouth black bass.....	240
Shad.....	†800,000	Rainbow trout.....	1,625
Florida:		Sunfish.....	200
Largemouth black bass.....	2,450	Yellow perch.....	800
Sunfish.....	400	Kentucky:	
Georgia:		Buffalofish.....	107,350
Brook trout.....	38,000	Carp.....	44,715
Catfish.....	3,060	Catfish.....	673,400
Crappie.....	300	Crappie.....	172,400
Largemouth black bass.....	{ †52,500	Largemouth black bass.....	{ 120,000
	45,405		6,675
Rainbow trout.....	70,000	Pike perch.....	4,900
Rock bass.....	100	Rainbow trout.....	500
Sunfish.....	37,250	Rock bass.....	4,775
Warmouth bass.....	100	Smallmouth black bass.....	{ †146,000
Hawaii: Rainbow trout.....	*25,000		2,500
Idaho:		Sunfish.....	131,750
Blackspotted trout.....	{ *50,000	White bass.....	800
	23,000	Yellow perch.....	{ †150,000
Brook trout.....	29,275		1,200
Landlocked salmon.....	*15,000	Louisiana:	
Rainbow trout.....	{ *128,000	Buffalofish.....	{ †10,040,000
	27,000		150
Whitefish.....	{ *500,000	Catfish.....	600
	†500,000	Crappie.....	530
	†500,000	Largemouth black bass.....	150

SUMMARY, BY SPECIES, OF DISTRIBUTION OF FISH AND EGGS, ETC.—Continued.

[Asterisk (*) denotes eggs; dagger (†), fry; all others are fingerlings or yearlings.]

UNITED STATES AND TERRITORIES—Continued.

State and species.	Number.	State and species.	Number.
Maine:		Minnesota—Continued.	
Atlantic salmon.....	11,387,000	Crappie.....	15,928,225
Brook trout.....	280	Drum.....	19,405
Flounder (winter).....	11,730,910	Lake trout.....	1670,000
Lake trout.....	1841,235,000	Largemouth black bass.....	152,765
Landlocked salmon.....	*50,000	Pike and pickerel.....	175,040
Pollock.....	*375,000	Pike perch.....	12,500,000
Rainbow trout.....	1208,115	Rainbow trout.....	56,400
Smelt.....	108,400	Smallmouth black bass.....	1,000
Sockeye salmon.....	111,906,000	Steelhead salmon.....	70,000
	126,000	Sunfish.....	11,727,340
	17,000,000	White bass.....	6,900
	117,500	Whitefish.....	1100,000
Maryland:		Yellow perch.....	4,912,812
Brook trout.....	18,700	Miscellaneous fishes.....	577,080
Catfish.....	1,500	Mississippi:	
Chinook salmon.....	2,500	Carp.....	84
Cisco.....	*300,000	Catfish.....	2,480
Crappie.....	2,180	Crappie.....	1,344
Lake trout.....	*1,000	Largemouth black bass.....	165,500
Largemouth black bass.....	4,350	Rainbow trout.....	37,640
Pike perch.....	*1,000,000	Rock bass.....	300
Rainbow trout.....	*150,000	Sunfish.....	49,000
Rock bass.....	37,750	Yellow perch.....	100
Shad.....	300	Missouri:	
Sunfish.....	17,436,250	Buffalofish.....	8,365
Whitefish.....	4,269	Carp.....	19,664
Yellow perch.....	*100,000	Catfish.....	269,638
	185,205,850	Crappie.....	130,570
	300	Drum.....	420
Massachusetts:		Largemouth black bass.....	21,361
Brook trout.....	257,525	Pike perch.....	470
Carp.....	100	Rainbow trout.....	59,329
Catfish.....	7,400	Rock bass.....	125
Cod.....	*208,800,000	Smallmouth black bass.....	12,200
Flounder (pole).....	1175,341,000	Sunfish.....	51,680
Flounder (winter).....	*19,410,000	White bass.....	840
Haddock.....	188,963,600	Yellow perch.....	768
	188,940,000	Miscellaneous fishes.....	480
	1271,880,000	Montana:	
Largemouth black bass.....	550	Blackspotted trout.....	1854,000
Pike perch.....	1725,000	Brook trout.....	200,000
Pollock.....	143,160,000	Catfish.....	436,175
Rainbow trout.....	*50,000	Grayling.....	1,600
Smallmouth black bass.....	29,600	Largemouth black bass.....	1,350
Sunfish.....	112,000	Rainbow trout.....	225,000
Michigan:		Steelhead salmon.....	775,000
Blackspotted trout.....	*10,000	Nebraska:	
Brook trout.....	1264,000	Brook trout.....	32,000
Carp.....	600,375	Largemouth black bass.....	1,000
Catfish.....	200	Rainbow trout.....	43,000
Crappie.....	6,950	Nevada: Rainbow trout.....	50,000
Lake trout.....	640	New Hampshire:	
Landlocked salmon.....	*1,000,000	Brook trout.....	1381,000
Largemouth black bass.....	114,875,000	Catfish.....	519,500
Pike perch.....	*10,000	Lake trout.....	4,800
Rainbow trout.....	16,400	Landlocked salmon.....	12,000
Rock bass.....	*277,250,000	Pike perch.....	1,400
Smallmouth black bass.....	18,040,000	Rainbow trout.....	20,000
Smelt.....	134,000	Steelhead salmon.....	5,830
Steelhead salmon.....	64,975	Whitefish.....	2,000,000
Sunfish.....	19,351		1500,000
Whitefish.....	*400,000		33,000
Yellow perch.....	123,810		114,200
	1,675		545
	*20,000,000		250,000
	129,500,000		
	1,200		
Minnesota:			
Brook trout.....	78,820		
Buffalofish.....	30,175		
Carp.....	1,190,320		
Catfish.....	10,740,580		

SUMMARY, BY SPECIES, OF DISTRIBUTION OF FISH AND EGGS, ETC.—Continued.

[Asterisk (*) denotes eggs; dagger (†), fry; all others are fingerlings or yearlings].

UNITED STATES AND TERRITORIES—Continued.

State and species.	Number.	State and species	Number.
New Jersey:		Ohio—Continued.	
Brook trout.....	7,400	Yellow perch.....	{ \$300,000 300
Catfish.....	600	Oklahoma:	
Crappie.....	400	Catfish.....	2,250
Largemouth black bass.....	4,040	Crappie.....	4,350
Pike perch.....	{ *1,000,000 †1,050,000	Largemouth black bass.....	2,720
Rainbow trout.....	4,000	Rainbow trout.....	{ *100,000 56,400
Sunfish.....	4,800	Rock bass.....	1,350
Yellow perch.....	100	Sunfish.....	2,000
New Mexico:		Yellow perch.....	2,200
Blackspotted trout.....	†73,500	Oregon:	
Brook trout.....	492,000	Black-spotted trout.....	101,500
Catfish.....	3,600	Brook trout.....	4,000
Crappie.....	3,755	Chinook salmon.....	{ *3,650,000 10,682,900
Largemouth black bass.....	900	Rainbow trout.....	{ *604,940 189,500
Rock bass.....	1,400	Shad.....	12,347,100
Sunfish.....	1,400	Silver salmon.....	417,050
Yellow perch.....	100	Steelhead salmon.....	1,316,000
New York:		Pennsylvania:	
Blackspotted trout.....	*10,000	Brook trout.....	{ 13,000 613,475
Brook trout.....	†446,000	Carp.....	85
Carp.....	42,000	Catfish.....	11,600
Catfish.....	7,200	Chinook salmon.....	10,000
Cisco.....	{ *121,210,000 †89,800,000	Cisco.....	*65,000,000
Crappie.....	750	Crappie.....	3,050
Lake trout.....	{ *1,510,000 †456,000	Lake trout.....	*50,000
Landlocked salmon.....	5,550	Landlocked salmon.....	*10,000
Largemouth black bass.....	*125,000	Largemouth black bass.....	24,870
Pike perch.....	4,000	Pike perch.....	†2,174,200
Rainbow trout.....	12,490	Rainbow trout.....	396,701
Steelhead salmon.....	*525,000	Rock bass.....	200
Whitefish.....	†10,495,800	Smallmouth black bass.....	125
Yellow perch.....	*10,000	Steelhead salmon.....	*55,000
North Carolina:		Sunfish.....	11,800
Brook trout.....	253,500	Whitefish.....	*10,000,000
Crappie.....	950	Yellow perch.....	1,175
Glut herring.....	†43,815,000	Rhode Island:	
Largemouth black bass.....	15,500	Brook trout.....	23,000
Rainbow trout.....	102,580	Flounder (winter).....	†78,432,000
Rock bass.....	453,100	Largemouth black bass.....	150
Shad.....	11,200	Smallmouth black bass.....	15,500
Smallmouth black bass.....	†15,746,000	South Carolina:	
Striped bass.....	1,635	Crappie.....	300
Sunfish.....	†20,181,000	Largemouth black bass.....	117,875
North Dakota:		Rainbow trout.....	16,000
Carp.....	5	Sunfish.....	5,000
Catfish.....	800	South Dakota:	
Crappie.....	500	Brook trout.....	379,100
Largemouth black bass.....	6,340	Catfish.....	400
Rock bass.....	400	Crappie.....	375
Ohio:		Loch Leven trout.....	2,000
Brook trout.....	†33,000	Lake trout.....	5,000
Buffalofish.....	1,000	Largemouth black bass.....	3,850
Carp.....	†63,325,000	Rainbow trout.....	84,110
Catfish.....	6,375	Sunfish.....	500
Crappie.....	1,800	Tennessee:	
Largemouth black bass.....	14,340	Brook trout.....	13,935
Pike perch.....	†12,600,000	Catfish.....	5,100
Rainbow trout.....	†10,000	Crappie.....	4,050
Rock bass.....	600	Largemouth black bass.....	{ †86,000 23,955
Smallmouth black bass.....	6,300	Rainbow trout.....	*35,000
Sunfish.....	10,570	Rock bass.....	171,000
Whitefish.....	{ *30,640,000 †167,500,000	Smallmouth black bass.....	8,900
		Sunfish.....	5,530
		Yellow perch.....	15,200
		Texas:	
		Catfish.....	70,350
		Crappie.....	5,904
		Largemouth black bass.....	257,370
		Rock bass.....	320
		Sunfish.....	74,872

SUMMARY, BY SPECIES, OF DISTRIBUTION OF FISH AND EGGS, ETC.—Continued.

[Asterisk (*) denotes eggs; dagger (†), fry; all others are fingerlings or yearlings.]

UNITED STATES AND TERRITORIES—Continued.

State and species.	Number.	State and species.	Number.
Utah:		Washington—Continued.	
Blackspotted trout.....	91,300	Sockeye salmon.....	1,800,000
Brook trout.....	188,300	Steelhead salmon.....	3,457,000
Catfish.....	2,250		* 69,000
Lake trout.....	*50,000		15,000
Rainbow trout.....	161,000		1,603,550
Whitefish.....	†100,000	West Virginia:	
Vermont:		Brook trout.....	212,515
Brook trout.....	†591,400	Catfish.....	8,100
	89,200	Crappie.....	2,700
	*25,000	Largemouth black bass.....	†6,000
Lake trout.....	†38,300	Rainbow trout.....	181,190
	4,900	Rock bass.....	175
Landlocked salmon.....	*20,000	Smallmouth black bass.....	†12,000
	6,000	Sunfish.....	3,400
Pike perch.....	*14,700,000	Yellow perch.....	600,800
Rainbow trout.....	†13,150,000	Wisconsin:	
	7,200	Brook trout.....	†103,000
Steelhead salmon.....	*25,000		655,355
	6,350	Buffalofish.....	799,520
Yellow perch.....	*12,000,000	Carp.....	2,039,104
	†2,000,000	Catfish.....	18,580,500
Virginia:		Crappie.....	14,470,540
Brook trout.....	118,350	Drum.....	†11,500
Catfish.....	1,300	Lake trout.....	†512,000
Crappie.....	160		15,000
Largemouth black bass.....	†15,000	Largemouth black bass.....	†17,990
	24,063	Pike and pickerel.....	322,130
Pike perch.....	†500,000	Pike perch.....	†5,000,000
Rainbow trout.....	279,600		†29,000
Rock bass.....	10,660	Rainbow trout.....	†150,190
Shad.....	†6,452,925	Sunfish.....	†12,687,546
	†88,500	White bass.....	6,620
Smallmouth black bass.....	100	Whitefish.....	28,760,000
Sunfish.....	8,225	Yellow perch.....	†1,012,230
Yellow perch.....	†74,113,600	Miscellaneous fishes.....	904,110
	300	Wyoming:	
Washington:		Blackspotted trout.....	*100,000
	*100,000		†2,044,200
Blackspotted trout.....	†9,000		182,300
	79,700	Brook trout.....	100,000
Brook trout.....	*300,000		302,400
	*130,000	Catfish.....	5,900
Chinook salmon.....	17,491,965	Lake trout.....	20,150
	†7,000,000	Largemouth black bass.....	8,660
Chum salmon.....	19,436,400	Loch Leven trout.....	28,000
	*75,000	Rainbow trout.....	†309,800
Rainbow trout.....	3,000		327,000
	†600,000	Smelt.....	*200,000
Silver salmon.....	6,069,100		

FOREIGN COUNTRIES.

Country and species.	Number.	Country and species.	Number.
Canada: ¹		Mexico:	
Blackspotted trout.....	*200,000	Largemouth black bass.....	600
Rainbow trout.....	*280,000	Yellow perch.....	500
Whitefish.....	*30,000,000	Switzerland:	
France: Rainbow trout.....	*150,000	Lake trout.....	*50,000
		Rainbow trout.....	*50,000

¹ In exchange for trout eggs 600,000 Atlantic salmon eggs were received from Canada.

ASSIGNMENTS TO STATE FISH COMMISSIONS.

The following table shows the States in which the State fish commissions, as applicants, received part of the distribution shown in

the preceding table and gives the species and numbers of fish and fish eggs assigned to each such commission:

ASSIGNMENTS OF FISH AND FISH EGGS TO STATE FISH COMMISSIONS, FISCAL YEAR 1921.

[NOTE.—Asterisk (*) denotes eggs; dagger (†), fry; all others are fingerlings.]

State and species.	Number.	State and species.	Number.
California: Chinook salmon.....	* 3,000,000	Nevada: Rainbow trout.....	* 50,000
Colorado: Rainbow trout.....	* 50,000	New Hampshire:	
Connecticut: Brook trout.....	52,000	Lake trout.....	* 25,000
Idaho:		Landlocked salmon.....	* 20,000
Blackspotted trout.....	* 50,000	Pike perch.....	* 2,000,000
Landlocked salmon.....	* 15,000	Whitefish.....	* 250,000
Rainbow trout.....	* 50,000	New Jersey: Pike perch.....	* 1,000,000
Whitefish.....	7,000	New York:	
Illinois:		Cisco.....	* 104,410,000
Catfish.....	25,300	Lake trout.....	* 1,500,000
Crappie.....	5,800	Landlocked salmon.....	* 100,000
Drum.....	175	Steelhead salmon.....	* 199,000
Largemouth black bass.....	200	Whitefish.....	* 29,200,000
Pikeperch.....	410	Ohio: Whitefish.....	* 23,640,000
Pike perch.....	250	Oklahoma:	
Rock bass.....	500	Rainbow trout.....	* 100,000
Sunfish.....	26,325	Rock bass.....	† 41,000
White bass.....	175	Rock bass.....	8,000
Whitefish.....	* 500,000	Rock bass.....	100
Iowa:		Oregon:	
Lake trout.....	* 50,000	Chinook salmon.....	* 3,650,000
Rainbow trout.....	* 62,000	Rainbow trout.....	* 604,940
Maine:		Pennsylvania:	
Lake trout.....	* 50,000	Chinook salmon.....	10,000
Landlocked salmon.....	* 475,000	Cisco.....	* 65,000,000
Maryland:		Lake trout.....	* 50,000
Cisco.....	* 300,000	Steelhead salmon.....	* 30,000
Lake trout.....	* 4,000	Whitefish.....	* 10,000,000
Pike perch.....	* 1,000,000	South Dakota:	
Rainbow trout.....	* 150,000	Brook trout.....	2,100
Whitefish.....	* 100,000	Rainbow trout.....	3,000
Massachusetts: Rainbow trout.....	* 50,000	Tennessee: Rainbow trout.....	* 55,000
Michigan:		Utah: Lake trout.....	* 50,000
Lake trout.....	* 1,000,000	Vermont:	
Landlocked salmon.....	* 10,000	Lake trout.....	* 25,000
Pike perch.....	* 223,200,000	Landlocked salmon.....	* 20,000
Smelt.....	* 200,000	Pike perch.....	* 14,700,000
Whitefish.....	* 20,000,000	Steelhead salmon.....	* 25,000
Minnesota:		Yellow perch.....	* 12,000,000
Catfish.....	6,800	Washington:	
Crappie.....	5,200	Blackspotted trout.....	* 75,000
Largemouth black bass.....	9,340	Rainbow trout.....	* 75,000
Steelhead salmon.....	* 70,000	Steelhead salmon.....	* 49,000
Sunfish.....	5,200	Wyoming:	
Yellow perch.....	2,250	Blackspotted trout.....	* 100,000
Missouri:		Brook trout.....	* 100,000
Rainbow trout.....	100	Catfish.....	1,200
Sunfish.....	100	Largemouth black bass.....	2,150
Montana:		Rainbow trout.....	* 309,800
Blackspotted trout.....	* 350,000		
Rainbow trout.....	* 150,000		
Steelhead salmon.....	* 75,000		
Nebraska:			
Brook trout.....	32,900		
Rainbow trout.....	30,000		
		Total.....	* 483,914,740
			† 41,000
			236,575

CONSIDERATIONS IN DISTRIBUTION OF COMMERCIAL FISHES.

The output of the bureau's hatcheries handling the commercial species is planted in local waters on the natural spawning grounds in so far as this may be desirable or practicable. This course is obviously necessary for the maintenance of the fishery involved, particularly where commercial fishing is aggressively prosecuted or where, as in the case of the anadromous fishes, commercial activities are coincident with the spawning season of the fish. It has been ably argued that the bureau's hatcheries belong to the people and that the output should be distributed more widely in neighbor-

ing States. If such a course were to be generally followed, the results would most certainly be disastrous. If a hatchery addressed to the propagation of a commercial species is successful in maintaining the fishery against the inroads of market fishing in the region covered by its activities, it may be fairly classed as efficient. If its annual output is only just sufficient to accomplish this purpose, it would be suicidal to divert any portion of it to other waters. Most of the States object, and with justice, through their fisheries authorities to the shipment outside their boundaries of eggs taken in their waters or the fry produced from such eggs.

The attitude of the fishermen is also a consideration. In most cases the bureau is to a large extent dependent on them for its egg collections. Speaking generally, the fishermen are deeply interested and render hearty cooperation. They watch the work with jealous interest, and any large or unwarranted diversion of eggs or fry would meet with strong opposition from them, and if persisted in would certainly result in refusal of the fishermen to deliver their eggs to the hatcheries. While the bureau's hatcheries are operated for the general good and the public is benefited by the increased food supply, the local fishermen are perhaps most intimately interested, and they should render every possible assistance to the hatcheries. Certain States now have laws whereby fishermen are given permits to fish during the closed season, with the restriction that all mature eggs shall be delivered to an agent of the bureau or the State for propagation. As the fishes are the property of the State, such a requirement is held to be just.

On the other hand, if a hatchery of the bureau succeeds in obtaining large numbers of eggs, more than are required for local waters, an intelligent distribution of the output to other waters is then permissible and even desirable. Under the most favorable conditions the results of natural spawning can not be expected to equal from 75 to 80 per cent of the numbers of young fishes put out by an efficient hatchery. Nature undoubtedly provides for a rather wide distribution of young fishes from natural reproduction. It is therefore not always advisable to limit the distribution of the output of a hatchery beyond reasonable restrictions, because if more young fishes are placed in a limited area than the waters can support they can not be expected to produce proportionate returns in marketable fish.

The following are among the points to be considered in connection with the distribution of the commercial species in new waters: (1) Do the waters under consideration support a commercial fishery? (2) Are the laws adequate for the protection of the fishes? (3) What are the conditions regarding dams or other barriers and pollution from trade or other forms of waste? (4) What is the attitude of local fishermen, and will they be willing to cooperate in the collection of eggs for the work of artificial propagation?

RESULTS OF PLANTING FISHES IN INTERIOR WATERS.

By E. C. FEARNOW,
Superintendent of Fish Distribution.

The question has frequently been asked whether the bureau's work in stocking streams and ponds in the interior States is producing satisfactory results. While the numerous letters received from ap-

plicants from time to time are favorable in character, no effort has heretofore been made to condense such information into a tabular form to indicate the general effects of the work.

The system of card-indexing applications, inaugurated in 1917, will in course of time give such information. However, it is believed that a table classifying the results accomplished during several years would be very useful in giving the bureau and the general public a concrete idea as to the value of the work that is being done in the interior States. A table of this character would also be invaluable when making assignments of fishes, as it would show what species are most productive in a given region.

The following is an explanation of the grades used in classifying the results: "Excellent" means that the fish increased in size and multiplied. "Good" is used where the applicant was satisfied, the fish attaining a large size, the number of fish apparently on the increase. "Fair" means that the results are only ordinary, many of the applicants merely use this word to express the results of the plants. "Overflow" is used where the dam of the pond broke and the fish escaped. This does not mean a loss of the fish, as in many instances the statement is made that certain streams were stocked by the breaking of dams. "Uncertain" is used where the applicant is undecided as to results. Most of the reports classified under this heading cover plants of fish made in large streams and lakes, where it was found difficult to determine whether the fish furnished by the bureau had actually produced results, owing to the waters being previously stocked with the same species. "Poor" covers reports which indicate that the plants were a failure. Failures are attributed to a number of causes as follows: Not adapted to the waters; fish received in poor condition; destroyed by snakes and other noxious animals. Many failures are attributed to the severe winter of 1916 and 1917, when ponds froze to an unprecedented depth. In some instances the fish were stolen.

The following table shows the general results of planting fishes during the fiscal year 1917:

GENERAL RESULTS, BY SPECIES, OF FISH PLANTINGS, FISCAL YEAR 1917.

Species.	Number of reports.	Increase and growth.					
		Excel- lent.	Good.	Fair.	Over- flow.	Uncer- tain.	Poor.
Catfish.....	127	34	47	25	2	8	11
Buffalofish.....	2	1	1				
Shad.....	1					1	
Whitefish.....	4	2	2				
Steelhead salmon.....	20	3	6	2		8	1
Landlocked salmon.....	28	8	15	3		1	1
Rainbow trout.....	589	157	224	98	7	50	53
Blackspotted trout.....	288	101	151	20		6	4
Loch Leven trout.....	6	2	3			1	
Brown trout.....	1	1					
Lake trout.....	21	4	9	2		3	3
Brook trout.....	1,514	532	717	124	6	45	90
Grayling.....	9	5	2	1		1	
Smelt.....	3		3				
Crappie.....	235	59	77	49	9	20	21
Largemouth black bass.....	927	270	415	108	32	52	50
Smallmouth black bass.....	326	101	131	41	5	29	19
Rock bass.....	76	14	21	19	4	9	9
Sunfish.....	280	57	88	59	25	18	33
Pike perch.....	97	43	19	11	1	14	9
Yellow perch.....	32	10	8	4		4	6
White perch.....	11		2	1		7	1
Total.....	4,597	1,402	1,943	574	92	277	309

Of the 4,597 reports received 30.5 per cent showed excellent results, 42.2 per cent good, 12.4 per cent fair, a little over 2 per cent overflow, over 6 per cent uncertain, and 6.5 per cent poor.

Black bass and sunfish appear to produce highly satisfactory results in most of the States, though many applicants have been dissatisfied with the sunfish on account of its small size, the growth attained not being as large as with some species. The stock of sunfish at most of the bureau's hatcheries has been improved in recent years, and it is believed that from now on this fish will give perfect satisfaction.

The rainbow trout appears to be especially well adapted to the waters of California, Colorado, New Mexico, Montana, North Carolina, and Wisconsin, while on the other hand a large percentage of failures or of only fairly good returns have been reported with that species in Arizona, Massachusetts, Ohio, New York, and Pennsylvania. This tends to accentuate the frequently expressed opinion that the rainbow trout is not as a rule adapted to eastern waters. It is true that the rainbow trout appears to have been very successfully established in West Virginia and in certain sections of Tennessee and North Carolina, but the data at hand would indicate that for eastern waters in general the conditions are better adapted to the brook trout. Numerous reports have been received to the effect that no rainbow trout were ever seen in waters where they had been planted. Mention of this failure of the rainbow trout to establish itself in certain sections of the country is very prominent in the reports.

DISTRIBUTION COSTS AND EQUIPMENT.

COST OF DISTRIBUTION.

As in all other lines of activity, the cost of distributing the output of the bureau's hatcheries has increased very considerably in recent years. The net increase in distribution costs since 1916 has amounted to approximately 150 per cent. The distribution of an output not appreciably decreased during this period, with no increase in funds provided for the conduct of the work, has been accomplished only by exercising the most rigid economy at every point. Unless additional funds for the propagation and distribution of food fishes is forthcoming, it may be necessary to inaugurate decided changes in the distribution methods to meet the increasing demands for fish.

During the fiscal year 1921 the cars of the bureau traveled 85,060 miles, while detached messengers in charge of live fishes traveled 385,988 miles, honoring approximately 10,000 applications for fish. The total cost of making this distribution, including maintenance and repairs to five distribution cars, amounted to \$69,600.

DISTRIBUTION CARS.

The two steel cars added to the distribution service during the spring of 1920 have fully demonstrated their superiority over the cars of wood construction. Their increased carrying capacity, together with lower cost for maintenance and repair, make them in every respect a high-class investment. It is recommended that the

two wooden cars still in use be replaced with cars of steel at an early date. In addition to the advantages already cited, it is frequently necessary to accept second-class service in the movement of the wooden cars, as many railroads refuse to move them in their first-class trains.

POCKET THERMOMETER FOR USE IN CARRYING LIVE FISH.

An improved device of interest in connection with the distribution of live fish is a pocket thermometer designed especially for the convenience of messengers in making shipments of fish or fish eggs. The column of mercury is protected by a hard rubber jacket, provided with a pocket clip and a ring, to which a cord may be attached. The advantages claimed for it over the type of thermometer previously used are its lighter weight and its greater convenience when in actual use. It is also less subject to breakage than the metal-jacketed thermometer.

Procedure in Assignments of Fishes to Applicants.

APPLICATION BLANKS.

On receipt of a request for fish the bureau supplies a blank calling for a complete description of the waters to be stocked. When the blank is properly executed and returned with the indorsement of a Member of Congress, the bureau endeavors to assign a suitable species of fish thereon, and the delivery is made at the earliest practicable date, at the applicant's railroad station, without cost to him. As the information requested on the application blank is used as a basis for determining the species to be assigned and to some extent the number of fish that will be furnished, the applicant should endeavor to have it as complete and accurate as possible.

SELECTION OF SPECIES.

One of the most perplexing problems confronting the division of fish culture is how to distribute the product of its hatcheries in a manner which will bring about the best results and at the same time be just and equitable to the large number of persons who every year apply to the bureau for fishes for stocking waters, both public and private.

Many persons who are familiar with some particular species of fish insist on its introduction into waters in which they may be interested. In one case an applicant who has recently moved to a new section of the country wants his favorite fish in the local waters, while in another case an applicant applies for a certain species on

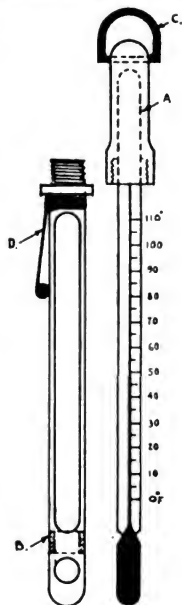


FIG. 5.—Pocket thermometer designed particularly for use in connection with the distribution of living fishes. (Designed by E. C. Fearnow.)

the recommendation of a friend or because the species has afforded him pleasure in another region. The importance of making a careful survey of the waters to be stocked, with the view of determining the species best adapted thereto, is often not recognized. It has been proved beyond a doubt that in nearly every case it is advisable to plant a species which is native to the locality, and in specifying his choice of fish the applicant should bear this in mind. Nonindigenous species should not be introduced unless it can be clearly shown that the native species, because of changed conditions, have failed to maintain themselves. There are many notable examples of the successful transplanting of fishes where the results have been highly beneficial. However, there is always an element of uncertainty in the planting of nonindigenous fishes in any region, and it should be undertaken only after a careful consideration of all phases of the situation, because if promiscuous plantings were to be permitted the work of fish culture might easily become a curse instead of a blessing to mankind.

The carp is an appropriate example of the results of the indiscriminate introduction of a foreign species. This fish was popular in the early history of fish culture in America, largely, perhaps, because it was a favorite with European fish-culturists and because of its rapid growth and ready adaptability to new surroundings. Through carelessness and indifference the carp became widely distributed in the waters of the country, with the result that in many sections a stigma will always apply to this sturdy fish. Nevertheless, there is a place in the piscatorial world for the carp, and for certain waters it fills a demand that can not be adequately met by any other species. It frequently happens that carp can be successfully and profitably propagated in waters that are quite unsuited to the finer species; and, under proper restrictions, this idea should be encouraged.

Aside from possible injury to indigenous species that may follow the introduction of foreign fishes, there are other important points to consider: Will the new inhabitants find a suitable temperature range and other conditions congenial to their reproduction? Will the food supply be of a suitable character and ample for their needs? Unless these essentials are present an introduced species can not establish itself in a new environment on a self-maintaining basis. Not infrequently species of fishes that are possessed of the highest food and game qualities in their natural habitat will, when transplanted in less favorable surroundings, degenerate to a point where they have no attractions either from a food or a game standpoint. Even the planting together of the same species of fish taken from different sections of the country or from different streams in the same section may be inadvisable. Certain investigators have expressed the belief that such plantings may lead, or in certain instances may have already led, to a form of hybridization which may result in seriously impairing the virility of the progeny.

Many of the more progressive State fish and game commissions have requested that all applications for certain species of nonindigenous or predacious fishes be submitted to them for approval. The bureau commends this policy, and all such applications, including those for carp, are referred before acceptance for the proper State

authorities to pass upon. Even with the State's indorsement the bureau reserves the right to exercise its judgment.

In connection with this matter, it appears expedient to continue the policy of refusing to supply the spiny-rayed fishes to applicants in the Pacific coast watershed. This step is essential for the protection of the important salmon and trout fisheries. The planting of the spiny-rayed fishes in the streams of the west coast might result in destroying millions of young salmon inhabiting such waters. The bureau maintains that the interests of the commercial fisheries are paramount to those of the sportsmen.

Eggs of certain species are furnished to State hatcheries where such a course appears to be to the interest of the work and, on rare occasions, to applicants having hatching facilities in cases where the eggs can be delivered more economically than the young fish.

SIZE OF ALLOTMENTS.

In determining the size of allotments of fishes on applications, the bureau is governed by the number and size of the requested species available for distribution in connection with the number of applications received for it, by the extent of water area to be stocked, and by the distance to which the fishes must be transported. It aims in every case to supply only a sufficient number of young fish for a brood stock, and the recipient is expected to provide for their protection until they have had time to mature and stock the waters through natural reproduction. The importance of adequate protection for fish furnished for stocking any body of water is so obvious that the bureau has seriously considered the advisability of curtailing or entirely discontinued the distribution of fish in localities where such protection is not afforded.

It is recognized that the larger bodies of water should receive the larger number of fishes for stocking purposes, but it does not appear judicious to honor applications for such waters to the exclusion of the smaller, though perhaps no less important, bodies of water. It is the policy of the bureau to apportion the output of its hatcheries in such a manner as will permit of filling all applications, so far as such a course may be practicable. Applications are frequently received from persons in sections remote from a fish-cultural station and in a part of the country where it is known that the waters are already abundantly stocked with desirable species. In such instances the bureau does not consider it wise to incur the expense of sending small numbers of artificially reared fishes to a considerable distance, and the applicants are so notified.

TIME AND METHOD OF DELIVERY.

Certain species, notably the brook trout and the rainbow trout, are planted whenever possible during the fingerling stage; but, as the rearing facilities are limited, the stock must be reduced in the early spring to prevent overcrowding. Thus, a part of the output is annually shipped in the fry stage. The distribution of the basses and other pond fishes begins about three weeks after they are hatched and extends over a period of several months, the last lots of fishes sent out ranging from 2 to 4 inches in length. The basses, sunfishes,

crappies, yellow perch, and other fishes rescued from landlocked ponds and pools in the Mississippi River Valley are from 3 to 6 inches long when distributed.

It is the policy of the bureau to fill applications in the order of their receipt and to deliver fishes assigned as soon thereafter as possible, but there are certain conditions connected with the distribution work which should be thoroughly understood by prospective applicants.

The cost involved in making shipments of fishes compels the bureau to exercise the utmost economy in arranging its distribution work. The delivery of special consignments and those intended for distant points must be delayed until a sufficient number of applications from the same section of the country have been received to warrant the expense of a messenger shipment. The bureau can not carry a stock of fish for delivery on demand, and when the supply of one year is exhausted no more are available until the crop of the succeeding year is ready to be sent out. The shipment of trout from the bureau's eastern stations begins early in March, and all applications received after that time are carried over until the following year. Trout distributions from stations in the Rocky Mountain regions are made between May and October, and, in order to insure early attention, applications from that part of the country should be in the Washington office of the bureau not later than May 1. The so-called warm-water fishes, including black basses, sunfish, and crappies, are shipped between May and December, and requests for them should be submitted prior to May 1.

The fishes are shipped in railroad cars especially designed for the purpose or in baggage cars, accompanied by a messenger, and the delivery is made at the applicant's railroad station without expense to him. When an application for fish is received by the bureau the person submitting it is immediately notified of the species assigned thereon and the approximate time when delivery may be expected. Full directions for the reception and care of the fish are also sent to him. Prior to the shipment a second notice is sent, usually a telegram, specifying the exact time when the assignment will arrive at his railroad station. If for some unforeseen reason it becomes necessary to postpone the delivery, the applicant is notified accordingly.



